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The 6502 Resource Magazine
PET • Apple • Atari • OSI • KIM • SYM • AIM

Clearing Apple II's Low-Resolution Graphics Screen

COMPUTE!

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March, 1981
Issue 10
Vol. 3, No. 3
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The Journal For Progressive Computing™

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Six-Gun Shootout Game For The OSI C1P

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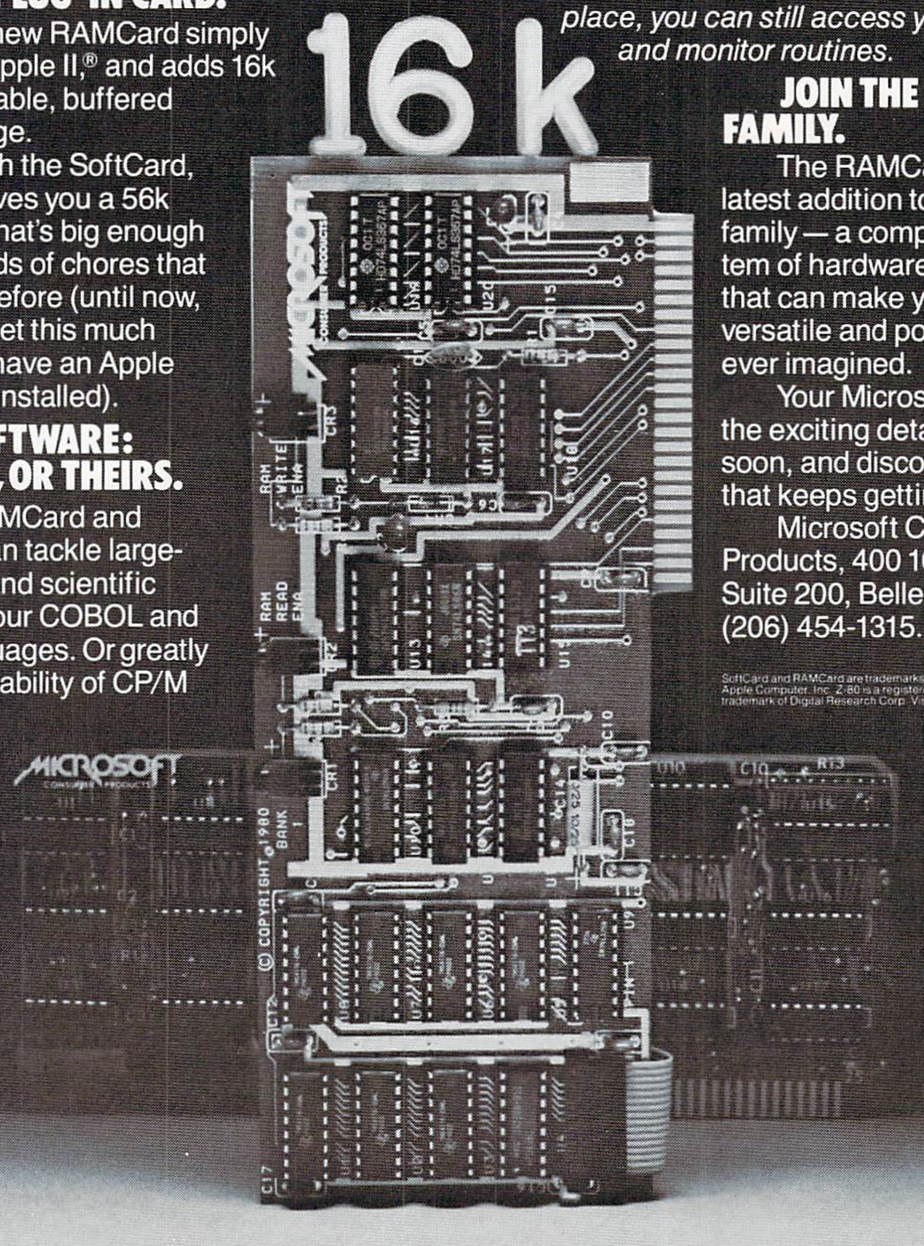

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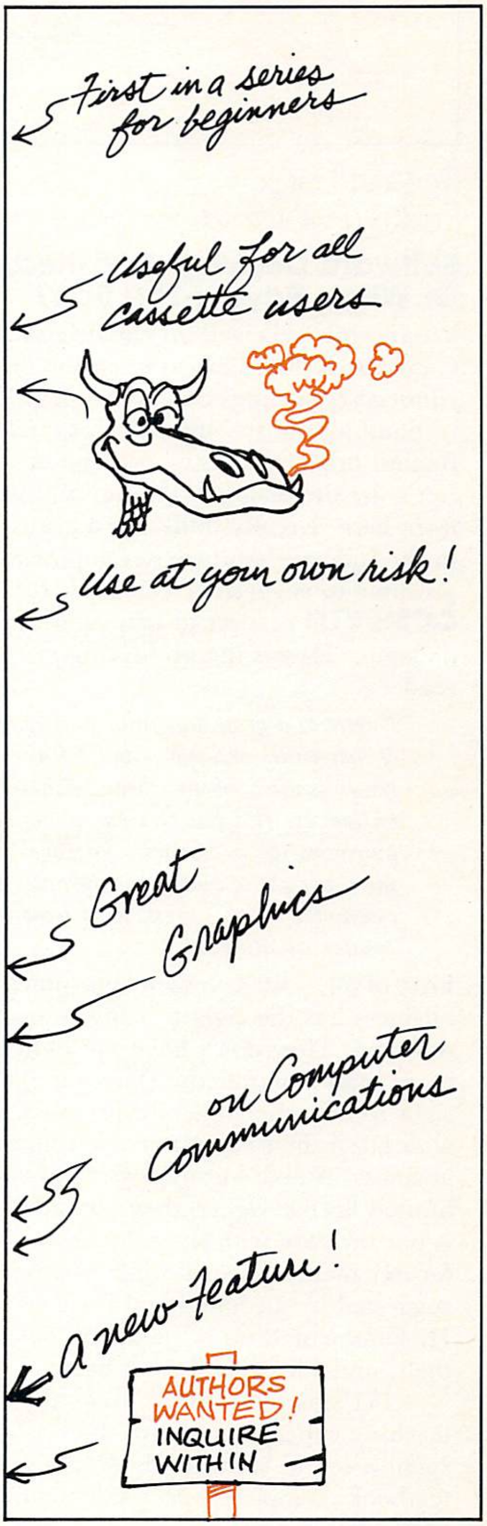

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COMPUTE! The Journal For Progressive Computing

The Editor's notes...

Robert Lock,
Editor/Publisher

Software Copying Revisited, Or Who's Paying The Bills?

We recently received an extensive letter from a Canadian subscriber commenting on the January editorial regarding software piracy. I'd like to respond to one specific point of the letter now, and request other readers to respond at length as well. Let's get the dialogue rolling, and we'll continue it from here. I really think it's a critical turning point in the industry's future development. I don't presume to suggest we can solve it here, but I'd like **COMPUTE!** readers to help spark and maintain the dialogue. Here's the prompting remark from the reader:

> *I agree to a great deal with your comment on copyright of magazines and books and software. I disliked your generalizations about schools. Schools are rather like big businesses. If a business has a number of machines and purchases say a "General Package", is it really breaking copyright to make enough copies to be used on all its machines? I don't think so. I reckon schools are in a similar situation...*

First of all, your comment presumes that big business has the right to copy (reproduce) proprietary software. They don't have the right to do so any more than Commodore (for example) would have the right to buy one copy of a program and give it away with all of their computers. Frequently, "big business" is able to buy a piece of software with limited license rights, they pay additional fees. This is not the case with the software we're talking about for our marketplace. I'd like to propose an analogy... suggested by an individual involved in software sales. He commented on a "textbook defense" of software theft, and I'll expand on it here:

Let's assume that you've taken your notes and teaching experiments from the last few years, and spent a recent summer developing them into a textbook, complete with student workbook full of exercises.

You find a publisher, obtain a contract wherein you receive a royalty on sales, go through numerous editings, and finally see your first copy in the mail.

Your book is selling for $19.95, and you're looking forward to some return from your royalties.

Time Passes

Sales are going along okay, but not up to your expectations. I mean it is an *excellent* book. You attend a regional educational conference, and run into Dr. So and So from a neighboring school district. He says, "We really enjoyed your new text, and it's super! We're using it in all of our classes next year."

Great (you think). Hundreds of sales. "Oh, by the way," he continues. "We thought $19.95 was pretty expensive, so we only bought one copy. We're running off class copies in our own print shop... See you later."

There goes your work, and your royalty. I assume you're concerned, if not angry. Is this any different in principle, from the defense of schools and software copying. Now we all know that realistically, the book would be rather expensive to duplicate. And I presume no one would doubt the illegality of the act. The essence of the argument would seem to become one of ease and expense of the copying. Software comes on an inexpensive, easily transportable media. Therefore, does copying it suddenly become okay? We need to give thought as well to the producers of the work. With commercial software, there's someone out there, after some amount of hard work, patiently waiting for their royalty.

I would suggest that users should not define a $19.95 software purchase as an unlimited right to copy, just as they wouldn't consider doing the same with a $19.95 textbook.

It would be more appropriate to approach producers about school licensing agreements, or multiple copies at school discount through their vendors, or whatever. This rational (negotiated) approach, if you will, would solve problems for several parties... Schools who currently buy multiple copies of software would save money, schools (individuals) who currently buy and reproduce would have full vendor support, and so on. The vendor support is an element we haven't touched on, but is part of the whole problem. I've been told, essentially, "Why should I support the educational market? They just steal my stuff."

A Post-Script

These comments should in no way infer that most schools aren't absolutely honest in their software purchases. We're just using this initial analogy to get the ball rolling. We've heard recently of a major industrial research center on the West Coast that's using approximately 80 copies of a $150.00 plus software package... copies cloned from their original single copy purchase. And how many times have you picked up that "back-up" copy of Cursor magazine to use just this once?

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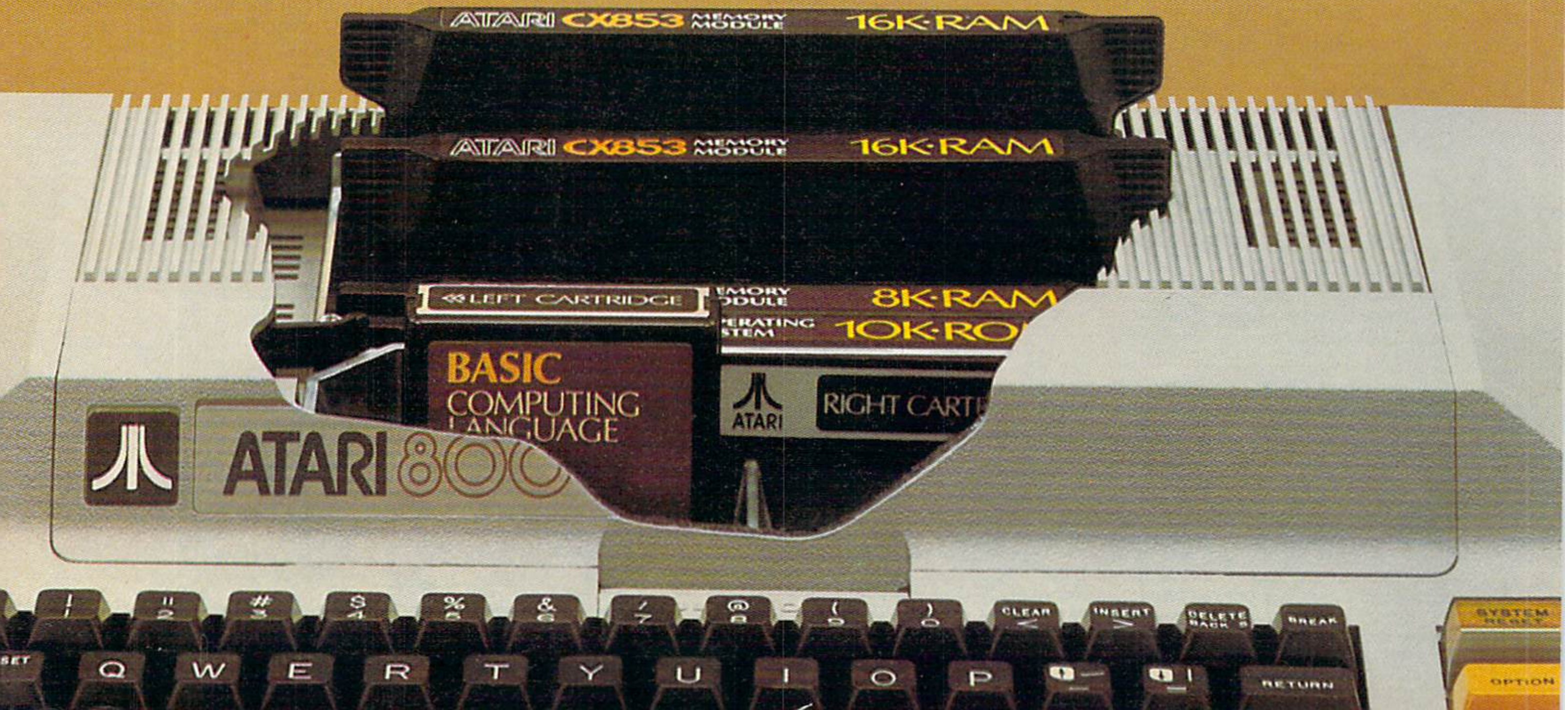

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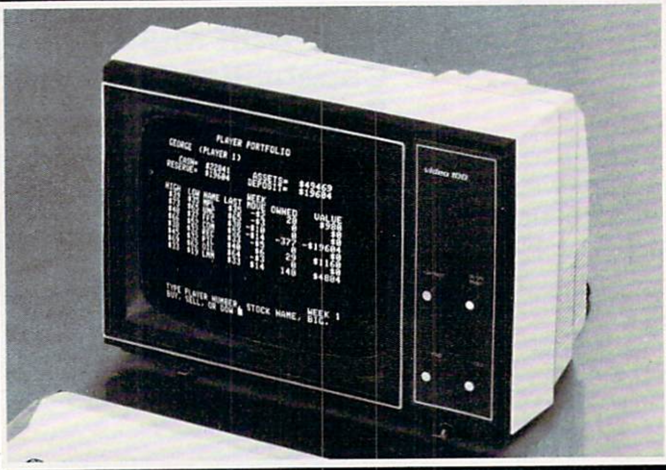

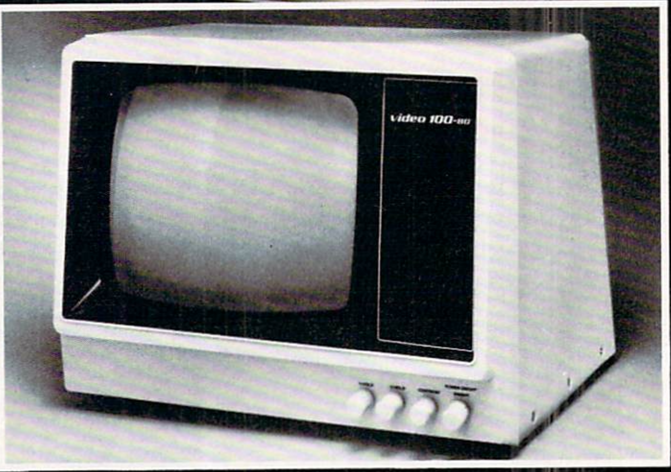

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machine. One of the magazines (Micro) checked with us to see our feelings on such advertising. We indicated that we wouldn't run such ads, given that the software in question could be used to produce duplicate copies of "protected" and proprietary software. We understand that Micro has since decided to do the same.

We applaud this move toward protecting the rights of the software industry, and encourage additional comment.

The Rights Of The Buyer

This isn't intended to be an inclusive comment on the rights of software buyers, but an attempt to open discussion. I already know of one **COMPUTE!** Associate Editor who has definite feelings on the subject. We'll try to get him involved in the discussion on these pages.

The buyer of a copy-protected diskette has potential problems, and deserves to be protected as well. Vendors of software would remove the legitimate need for copying software if they would adopt a customer oriented, fully responsive plan for allowing licensed owners of software to quickly, conveniently and most of all, economically, obtain a back-up in the case of failure of a diskette.

The principal of repetitive back-ups is rightly embedded in the history of data processing technique, and can't be ignored in an industry rush to protect proprietary software from duplication. Personal Software appears to be trying to deal with this with Visicalc, and I'm sure other vendors are as well. The vendor has the right to protect proprietary software. The vendor also has the obligation to protect the customer's interest. The extent of this protection of the mutual interests of both will ultimately help define the existence of the protection violation market, and the strength of the software market as a whole. We'll eagerly await your comments.

The Boston Commodore Show; VIC Meets The Consumer

Judging from the interest in VIC at Commodore's Boston Show (February 6, 7), the $299.95 color computer entry from Commodore will be well received. One of the biggest unresolved problems of the moment is: "When will production be up and running?" They're currently saying March-April, and I think they'll make it. BASIC, by the way, is the well-known upgrade ROM set, and color animation capabilities are rather nice. We hope that Commodore will see their way to a nice introductory package price. Watch our April issue for a full review of VIC, and mid-April for the availability of our brand new quarterly magazine, exclusively for the VIC. It's called Home and Educational COMPUTING!, and is announced elsewhere in this issue.

Atari Update

They're still selling as fast as they can make them. What else can we say? ©

A Beginners Guide To COMPUTE!

If you're just getting started with your computer or with **COMPUTE!**, here are several notes to help you use **COMPUTE!**:

Presentation

In every issue we try to present a balanced group of articles ranging from material for beginners to material for old hands. Frequently, a beginner can get a great deal out of an advanced article, even though much of it may be over his or her head.

Program listings are presented as legibly as possible. Pet programs are generally reproduced and reformatted here where we've developed software to "translate" the special Pet graphics characters into characters printable by our equipment. These are explained below:

Program Listings for COMPUTE

Cursor control characters will appear in source listings as shown below:

```
h̲=HOME          , ĥ=CLEAR SCREEN
↓=DOWN CURSOR   , ↑=UP CURSOR
→=RIGHT CURSOR, ←=LEFT CURSOR
r̲=REVERSE       , r̂=REVERSE OFF
```

Graphics (i.e. shifted) characters will appear as the unshifted alphanumeric character with an underline. This does not apply to the cursor control characters. The Spinwriter thimble doesn't have a backarrow symbol, so a "~" is used instead.

The "¬" is used to indicate the beginning of a continuation line. It is also used to indicate the end of a line which ends with a space. This prevents any spaces from being hidden.

If, for example, you're an Apple owner using a Pet program that's reproduced in this fashion, you'll need to be familiar with these special characters so you can program around them. As more computers implement versions of MicroSoft BASIC, the programs should become more and more transportable. ©

Reader's Feedback *will return next issue in a revised and expanded format. Keep those letters and editor's feedback cards coming. By the way, see our New Products section, new this issue. RCL*

A 6502 Version Of The Winter Consumer Electronics Show: January, 1981

David D. Thornburg
Innovision
P.O. Box 1317
Los Altos, CA 94022

At a time when most normal folks are taking down the holiday decorations, and preparing for the new year, those of us who haunt the trade shows were anxiously preparing for our January fix — the Winter CES (Consumer Electronics Show) held in Las Vegas. Unlike specialized trade shows, like Comdex, the CES has exhibits covering almost all consumer products that are likely to contain silicon. Because of the continuing recession, only 55,000 people attended this show which was held in the Las Vegas Convention Center and in two nearby hotels. Rather than describe some of the more novel products, such as the talking microwave oven (with, would you believe it, a Japanese-English accent), or the solar rechargeable flashlight (look, I couldn't make this stuff up if I tried, so believe me!), I decided to mention some of the products of greater relevance to **COMPUTE!** readers: the 6502-based microcomputers which were displayed.

As far as hardware is concerned, the big hit of the show was the **Commodore VIC-20** (your fearless scribe is preparing a review of this machine to appear in a forthcoming issue of **COMPUTE!**). At a suggested retail price of $299, it is apparent to me that Commodore has the technical ability to give the Radio Shack Color Computer a solid run for its money. In fact, I expect VIC sales to place Commodore firmly in the number two spot for total machine placements, and perhaps to even edge up on our Texas friends. The styling is beautiful and the price is right, but even more importantly, Commodore is going all out to support the cottage industry that has kept the PET well supplied with software. Watch for the FCC approval, followed by the VIC showing up in your corner computer store sometime in March or April.

Software had its day at CES also. **Atari** showed both their **new PILOT cartridge** (see this month's Computers and Society column), and also showed their **word processor package.** Both pieces of software are very well done, and should do much to help Atari on its accelerating growth curve. While I didn't see any new Atari hardware on the floor, there were rumors of some nice new things hidden away in their hospitality suite. It is apparent that Atari is in this game for the long haul.

Those of you who are waiting for the keyboard portion of the **Mattel Intellivision** (complete with a 6502-based computer with 16 K of RAM and a Microsoft BASIC) will have to wait a little longer. Once again they say that deliveries will begin in March — only the year has changed.

The **absence of Apple and OSI from this show** was noted. Apple has apparently decided to focus its efforts in the small business market, and leave the home computer market to fend for itself for awhile. I saw lots of Apple folks at the show, however, so they can't have totally lost interest in the consumer

For those of us who have invested in 6502-based systems, it is heartening to see that this processor continues to be among the most popular.

market. OSI, on the other hand, has had nice exhibits at this show for quite some time, and I have to assume (without checking it out) that their absence was due more to their recent acquisition than to any plans they have to depart from the low-end market.

The **6502-based hand held computer from Matsushita** (which will be marketed both through Panasonic and Quasar) was shown running a communications interface hooked up to the Source. It appears that the software for this computer is almost finished, and that we can expect to see it hit the market in a few months. Considering that this computer, with modem and coupler, will have a retail price in the $1,000 range, I find its small keyboard and one-line liquid crystal display to be annoying. On the other hand, if you want the ultimate in portability, this might be just the computer for you.

It was interesting to note that all the other computers at the CES (excepting the TI 99/4) used either the 8080 or Z-80 microprocessor. There were no new 16-bit computers introduced. For those of us who have invested in 6502-based systems, it is heartening to see that this processor continues to be among the most popular. It is clear that our investment will retain its value for quite some time.

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The Beginner's Page

Robert Lock,
Editor/Publisher

COMPUTE! is a specialized resource magazine that provides editorial coverage of a family of microcomputers that share a common "central processing" chip — the 6502. With the proliferation of small computers, we find that you can obtain more useful and relevant information in a magazine that doesn't (for example) cover the TRS-80 computer line. It, by the way, uses a different microprocessor chip: the Z-80. A whole different family of chips, and a different family of machines.

Mapping COMPUTE!

We're organized sequentially, with the front section of the magazine devoted to material of general interest and utility. The following sections are devoted to specific machines. These are called Gazettes, and contain information pertinent to your special machine. Frequently, however, you'll find useful material in other sections (Gazettes) of the magazine.

Where The Sets Merge, Or Common Interests

All of your machines have available a programming language called BASIC. **BASIC** stands for **B**eginners **A**ll-purpose **S**ymbolic **I**nstruction **C**ode. It's what is called a higher-level language. BASIC differs somewhat on the different machines, so you'll find some things in common with other BASIC's and some differences. In practice, BASIC simply makes it easier for you to talk to your 6502 microprocessor. The 6502 sits at the heart of your machine. It and supporting "firmware" and "hardware" make your machine capable of doing what it does. In a nutshell, you feed your 6502 instructions that it can act on. It only acts on very picky little sets of numbers, and that's why you have BASIC. BASIC serves as an English-language like translator for you, taking your instructions in a pseudo-English format and translating them for the 6502.

Other portions of firmware contribute to your machine's features. Someone has already written a 6502 program that resides in your machine, interacting with BASIC, and passing out instructions to the 6502. This program (or set of programs) is called the **Operating System**. It is permanently inscribed onto a chip or set of chips inside your machine. Its permanence implies its generic name: firmware. Hardware characteristics also help define your machine and its capabilities. Memory is one important characteristic. Memory is your working space. It's much like the work area you have on top of your table. Let's assume you have a table of x size, and you're ready to start a project. You have a set of notes and instructions previously developed to help you with your task. Let's also assume that you may not write on your previous notes, but you may refer to and use them freely. These notes and instructions are much like one kind of memory in your computer: **ROM. R**ead **O**nly **M**emory is memory that has a program already saved on it. The program doesn't go away when you turn your machine on and off. This, then, is your firmware: the ROM, or set of ROMs, where "permanent" programs, or sets of instructions, reside. The number of instructions your Operating System can have, e.g. in part its complexity, is then directly related to the amount of ROM in your machine. Let's stack up these beginning "notes" on one side of your desktop. We'll assume that they take up one-quarter of the table space. We can use them always, but we can't stack anything else there.

Now let's add a clean notepad to our workspace. We'll call this our work area. Everytime we come back to our desk to work, we'll assume we have x amount of clean space to put our notepad on, and do whatever work we want. This "flexible" work area equates to **RAM. R**andom **A**ccess **M**emory is another type of memory inside your computer. Unlike ROM, which has a set of instructions "built-in", RAM is empty. It's your working area; the space you use for putting in your own information. After you put something in it, you can use it, reading from it later, and so on, just like your note pad. And like your notepad, you can continue to return to it, reading from it and writing to it. Until, of course, you turn your computer off. Your RAM is wiped clean when the power goes away.

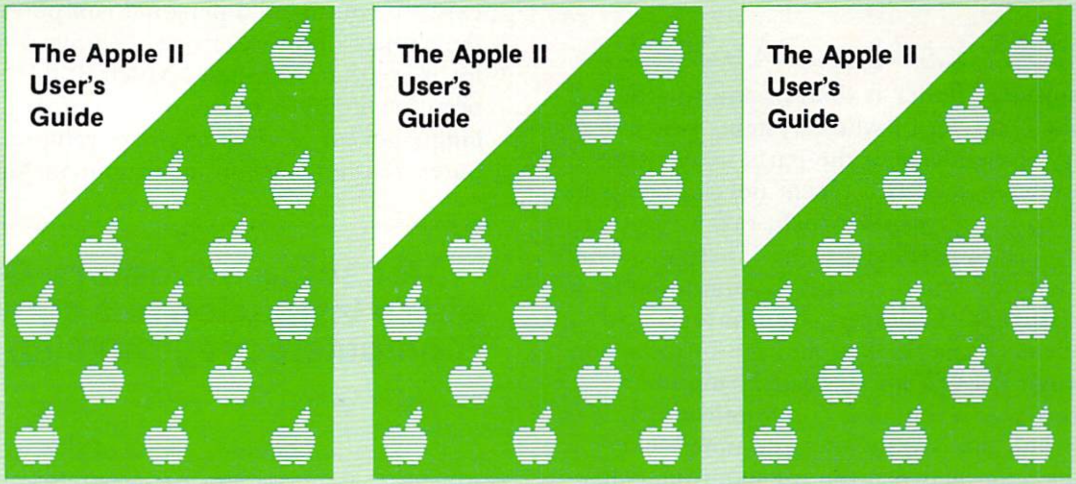
Storage Media

This is why your computer has a storage device. Whether it's a tape cassette or a disk drive, it's there to save the contents of your RAM. Let's assume you've entered a set of instructions. We know where they are: they're in RAM. We also know that once the machine is turned off, these instructions will be erased from RAM. The solution is simple. Save them somewhere. When you want them back, your Operating System will take care of reading them back into RAM.

Where Are We?

We've just covered the areas that make your small computer a truly remarkable and powerful device. It has a set of predefined features, controlled by permanent instructions, and aided by design features that always make it "act" the same way. Your calculator is much like this; and your microwave oven; and the host of other consumer products that are utilizing some form of microprocessor chip. The firmware in these devices is simply a set of permanent instructions to a computer chip. But your computer has a whole lot more. It has RAM, allowing you work space to develop your own sets of instructions to your computer chip. Aha! Tremendous flexibility. And it has a storage device, allowing you to save the effort of your labors, retrieving them at will for use and further development. ©

Osborne Polishes THE APPLE



and Publishes THE GUIDE

The Apple II User's Guide by Lon Poole, Martin McNiff, and Steven Cook #46-2, $15. ☐

This Guide is the key to unlocking the full power of your Apple II or Apple II plus computer. The Apple II User's Guide brings together in one place a wealth of information for Apple computer users. It will tell you more about your Apple than any other single source.

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This book will save you both time and effort. No longer will you have to search endlessly for useful information. It's all here, in the Apple II User's Guide, thoughtfully organized and easy to use.

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More Osborne Books for Apple Users

6502 Assembly Language Programming
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Book #27-6 $16.99, 606 pp. ☐

Some Common BASIC Programs
by L. Poole and M. Borchers
Written in a subset of standard BASIC that is compatible with many microcomputers, this book contains 76 useful and easy-to-use programs. The book explains how each program works, shows sample runs, and has program listings with remarks. "If you want to do mathematics or statistical programming on your computer, this book is a must." *ON COMPUTING* Magazine
Book #06-3, $14.99, 200 pp. ☐

Practical Basic Programs
edited by Lon Poole
Here's a collection of 40 programs you can easily key in and use on most microcomputers. *Practical Basic Programs* is especially useful in small business applications. It solves problems in finance, management, and statistics. The book contains sample runs, practical problems, BASIC source listings, and an easy-to-follow narrative to help you realize the potential uses of each program.
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Computers and Society

David D. Thornburg
Innovision
P.O. Box 1317, Los Altos, CA 94022

As R. Buckminster Fuller is fond of pointing out, synergy is the behavior of whole systems which is not predicted by the behavior of the parts taken separately. There have been two recent developments in the personal computer world which, taken together, have the promise of true synergism. These events are the publication of Seymour Papert's long-awaited book: **Mindstorms - Children, Computers, and Powerful Ideas** (Basic Books), and the introduction of the language PILOT for the Atari computers.

Since this year's theme is communications, it is only appropriate that we spend some time looking at the communication between the user and the computer. While the mechanical means through which this communication takes place are worthy of extensive discussion, I want to concentrate this month on the nature of the language through which we interact with computers, since this also is an area of intense importance.

One might argue that there is little reason for concern with computer languages at this point, since we all have access to fairly powerful versions of BASIC on our computers. We might all agree that BASIC is not terribly hard to learn, and that there are lots of very exciting BASIC programs, and even that BASIC has become the *de facto* standard computer language for personal computers.

But even with the tremendous penetration of BASIC in the marketplace, I have yet to find any serious computer user (regardless of age) who really likes it. At the primitive level of programming at which we all start, BASIC works pretty well. But as we get more sophisticated, most of us find ourselves writing code that we can't understand two weeks after we write it.

Of course, there are detractors of BASIC who feel that languages like PASCAL are the solution. I must confess that I find PASCAL lacking in that it doesn't encourage the user to sit down and start writing some small part of a program, to play with the bits and pieces, and to then bring everything together later on. This is one area in which BASIC excels. For those who feel that people should be organized when they write a program, PASCAL (and C and other ''serious'' languages) may very well be the best choice. But what about the new computer user who wants to build a highly interactive program, or the child who wants to explore concepts in geometry through the experience of programming rather than through playing a pre-defined ''game'' or sitting at a ''canned'' CAI lesson? These people need languages which are interactive, highly flexible, extraordinarily powerful, and are easy to get started with.

LOGO And PILOT Are Two Such Languages.

While LOGO (as this is being written) does not yet exist on commercial personal computers, it has been the subject of an extensive research program at MIT for more than a decade. Much of the research has been devoted less to the development of computer languages *per se*, than to the development of a computer assisted learning environment for children. The goals, aspirations and results of this work are the subject of Papert's **Mindstorms.** It is hard to imagine any person who is intensely concerned with the use of computers by children who would fail to be moved by the sweeping vision implicit in Papert's work. Writing from the perspective of a mathemetician who spent much time with Jean Paiget, Papert presents a variation on the Paigetian model of the ''child as builder'' in that he sees the need for children to have an abundance of materials with which to build things.

...for some educators, Computer Aided Instruction has come to mean "computers programming children".

That the computer can be one such building tool is the cornerstone of the many computer literacy activities we see springing up around the world. But, for some educators, Computer Aided Instruction (CAI) has come to mean ''computers programming children''. There is much to be gained from reversing this process — and that is where the need arises for an exceptionally powerful (and easy to learn) computer language.

LOGO is a highly interactive language which contains a graphics environment containing something called a ''Turtle''. The Turtle is a non-Euclidian point (having both position and direction, rather than a position alone). The programmer can send messages to the Turtle which cause pictures to be drawn on the display screen. Those of you who are familiar with the Milton Bradley **Big Trak** are already familiar with this idea. To draw a square on the screen, for example, a child working in the Turtle microworld might type:

```
FORWARD 100
RIGHT 90
FORWARD 100
RIGHT 90
FORWARD 100
RIGHT 90
FORWARD 100
RIGHT 90
```

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ACROSS FROM RFK STADIUM
THURS-SUN
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OCTOBER 29-NOVEMBER 1
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As each instruction is executed, the Turtle first moves forward by 100 units, and then turns right by 90 degrees, drawing its path on the screen as it moves. The desired square thus takes shape on the screen. A programmer wishing to use squares quite frequently might wish to extend the repetoire of commands the Turtle uses by defining a new procedure which the Turtle then "understands":

...children are asked to find the bug by "playing Turtle".

```
TO SQUARE
REPEAT 4
  FORWARD 100
  RIGHT 90
END
```

If squares of arbitrary size are required, one might write:

```
TO SQUARE :SIZE
REPEAT 4
  FORWARD :SIZE
  RIGHT 90
END
```

and then, anytime a square is desired, one would type, for example,

```
SQUARE 47
```

to draw a square with each side 47 units long.

The value of using the Turtle environment in an interactive way is expressed by Papert this way:

> *Working in Turtle microworlds is a model for what it is to get to know an idea the way you know a person. Students who work in these environments certainly do discover facts, make propositional generalizations, and learn skills. But the primary learning experience is not one of memorizing facts or of practicing skills. Rather, it is getting to know the Turtle, exploring what a Turtle can and cannot do. It is similar to the child's every day activities, such as making mudpies and testing the limits of parental authority — all of which have a component of "getting to know".*

One of the more valuable experiences for children involved with computers is learning how to "debug" a program with errors in it. Traditionally, we are taught that errors are bad. Papert shows that, by accepting the inevitability of errors in programs, children can learn to analyze the results of the error and then learn to avoid the error in the future, and to "patch" it in the meantime.

In order to make the debugging process as meaningful as possible, children are asked to find the bug by "playing Turtle". The child then walks

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The *User's Guide* also includes *Novice Notes* for the absolute beginner.We don't talk down to you,but we do remember how it feels to be awash in a sea of *bytes* and *bits* and other technical jargon. If you are new to programming, **IRIDIS** is one of the easiest ways you can learn how to get the most out of your ATARI. If you are an old hand, you'll be delighted by the technical excellence of our programs. (We are the people who have published **CURSOR** for the Commodore PET since July, 1978.)

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around the floor, executing each instruction in turn until the "faulty" instruction is found. But doesn't this method for finding errors lead the child to "thinking like the computer"? Papert sees this experience in a larger context. He says:

> *In my experience, the fact that I ask myself to "think like a computer" does not close off other epistemologies. It simply opens new ways for approaching thinking. The cultural assimilation of the computer presence will give rise to computer literacy. This phrase is often taken as meaning knowing how to program, or knowing about the varied uses made of computers. But true computer literacy is not just knowing how to make use of computers and computational ideas. It is knowing when it is appropriate to do so.*

While Papert is quite heartened by the growth of the personal computer industry, since this growth will

He likens BASIC to the QWERTY layout on the keyboard—an artifact from a time when better things didn't exist.

result in children having ever easier access to computers, he is frustrated by the limitations of these machines and by the extremely strong penetration of BASIC into the marketplace. He likens BASIC to the QWERTY layout on the keyboard — an artifact from a time when better ways didn't exist. But what of LOGO itself? This language will not be forever locked in the University laboratory. Versions for the TI 99/4 and the Apple computer will probably come into general availability soon.

Even if LOGO, with all its power, doesn't make its appearance in the marketplace soon, I feel that many of Papert's ideas can be implemented today on the small computers whose capabilities he dislikes, through the medium of the language PILOT.

As normally written, PILOT interpreters allow the user to create spectacular text manipulation programs (*c.f.*, the article by Thornburg and Thornburg in the first issue of **COMPUTE!**). Recent embellishments have made PILOT a splendid language to use on computers with high quality graphics environments, such as the Atari 400 and 800. Those of us who use Atari computers can, with Atari PILOT, do many of the things Papert does with LOGO.

Those of you who are familiar with PILOT probably think of it as a language best suited for creating text-based learning materials. My view of the language is far more open than that, because it is so easy to teach to youngsters. It has long been my dream to see the superb text manipulative power of PILOT extended to give the user similar power to

create pictures. The Atari PILOT is the answer to this dream since it contains a graphics package that is, in some ways, very similar to the Turtle graphics of LOGO.

For example, an Atari computer user running PILOT might draw a square this way:

```
GR: CLEAR
GR: DRAW 25
GR: TURN 90
GR: DRAW 25
GR: TURN 90
GR: DRAW 25
GR: TURN 90
GR: DRAW 25
GR: TURN 90
```

As each instruction is carried out, the square begins to take shape on the screen. If the user wants to draw lots of squares PILOT allows one to create a "module" as a deferred program. By typing AUTO at the command level, and then typing:

```
*SQUARE
  GR: 4(DRAW 25; TURN 90)
E:
```

A module (SQUARE) is created. On leaving the AUTO mode (the AUTO mode automatically places line numbers in front of each statement, thus keeping them from being executed immediately), the user can draw a square by typing:

```
U: *SQUARE
```

in which **U:** is the USE operator found in all versions of PILOT.

My reasons for giving this particular example are two-fold. First, it shows the similarity between the Turtle graphics of Atari PILOT and that of LOGO. Secondly, it shows that PILOT can be used in an interactive mode which combines deferred program segments (modules) with immediate execution of commands.

Can (or should) PILOT replace BASIC? I can only answer by saying that, on the Atari computers, it has for me. I find the language much easier to learn, much easier to use, and capable of doing anything I have ever wanted to do. One of its major features (especially important when working with children) is that a PILOT program can be read by someone other than its author. This is rarely the case for large BASIC programs.

Finally, while most users will want to use PILOT to write self contained programs, I am very happy with the fact that the Atari implementation of PILOT allows the user to interact with the language without having to write "finished" programs. As Papert has shown, the value of "playing around" with an interactive language can be great for all users, and especially for children. ©

Editor's Note: Atari PILOT is not expected to be available until late spring. Check with your dealer for more information. RCL

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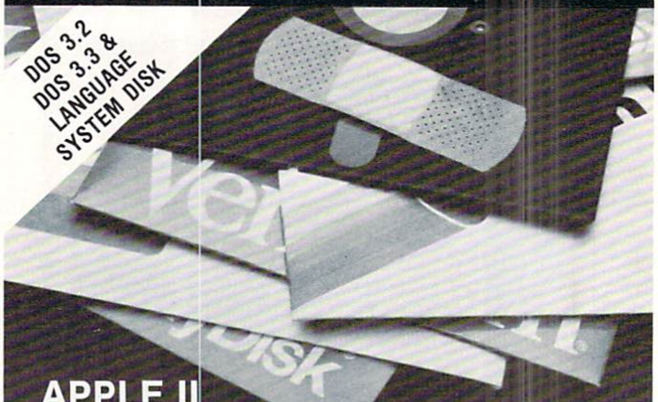

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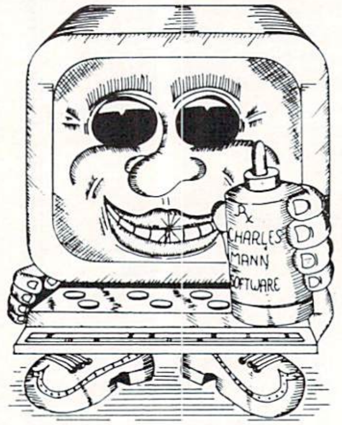

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Editor's Note: Although Richard refers to the PET in this overview, I recommend this article to all who've expressed interest in machine language. RCL

Taking the Plunge— Machine Language Programming for Beginners

Richard Mansfield
Philipsburg, PA

If you have been using BASIC for a while now, you can probably go in and out of STR$ and VAL and there is no mystery to ON GOTO anymore. In fact, the only strange BASIC statements at this point are USR, SYS, and PEEK and POKE. They are gateways into Machine Language and that is still an unknown area. Take heart. It is said that people who first learned programming using Machine Language (M.L.) can find BASIC confusing.

In this article I will discuss aspects of M.L. programming which were unclear or difficult for me when I went on to learn M.L. after a fairly complete grasp of BASIC. I had seen "assembler listings" in magazines with their usual warning that the numbers must be entered *exactly* or the program could not work. And the numbers themselves were in HEX—7 and 10 was 0A! It seemed difficult. It really isn't that hard (but try to explain to a non-computerist that BASIC isn't that hard).

The first thing to do is to get a good book on 6502 (our computers' CPU chip) programming. There are five or so, but among the best are *"Programming the 6502"* by R. Zaks (Sybex) and *"6502 Assembly Language Programming"* by Lance Leventhal (Osborne). You can ignore such information as signed binary, floating point, octal, hardware and input-output chapters. What you want to learn is the meaning of hexadecimal and binary — two new ways to express numbers.

"Machine Language" means that you are entering statements in exactly the way that your 6502 processor will see them. By contrast, a BASIC statement such as LOAD represents hundreds of M.L. statements which have already been programmed by somebody at Microsoft and frozen into ROM chips inside the computer. When the computer (always scanning and waiting for carriage returns) finds that you have typed LOAD, it has a list of addresses and chooses the one associated with LOAD and jumps (JMP it's called) to the address in ROM where the proper sequence of M.L. operations is set down. This sequence is like a subroutine. And BASIC itself is nothing more than a huge web of thousands of M.L. subroutines. In the PET, for example, if you want to jump to the subroutine that sends the number in the 6502's "accumulator" (defined below) to your screen, you type SYS 65490 and the computer is thrown into its M.L. mode and told to start doing the task which begins at the 65490th memory cell in it's brain. That is near the top. There are maps of the computer's memory cells.

A Simple Map of the PET's Brain

0 to 1023—RAM (you can change it's contents), but used by BASIC to store addresses (called **pointers**), temporary data (such as what you type in from the keyboard, called **input buffer**), temporary data of its own in a **stack**, and all manner of reminders to itself about whether or not the tape recorder is on, etc., (called **flags**). So, if you tamper with these memory cells, you might confuse the computer enough to send it into an **endless loop** within itself and you cannot communicate with it again until you turn off the power and force it to **reset** (get itself together).

1024 to 32767—your RAM to use for BASIC programs, or M.L. programs which you put together. Unlike ROM, these cells can each contain any number from 0 to 255. ROM is frozen with its various numbers carved in forever. All PETs start their RAM here, but if you have 8k then you can only use RAM up 8000 cells from 1024.

32768 to 33791—the cells of your screen (40 column screens).

36864 to 45055—space for you to add new ROM chips such as Toolkit.

45056 to 65535—BASIC itself, along with the computer's instructions about interrupting itself (if you should press STOP, for example), how to run the T.V. (**CRT** or **monitor**), how to talk to the peripherals (**I/O**), and other housekeeping chores (called the **operating system**).

Far more detailed maps are available to tell you exactly where things happen inside. See back issues of COMPUTE! for Jim Butterfield's exhaustive maps for PET (issues #1, #6), APPLE (issue #2), and others (issue #2).

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The Monitor and the Three Kinds of Numbers

It is important in learning M.L. programming to grasp a distinction between the three ways that the computer could see any number. Depending on the *context*, it will think that a given number is either a datum, an address, or instruction (a task it should perform, such as fetching something). To illustrate this distinction, we can construct a simple, but very common, M.L. routine using the PET M.L. Monitor. (If you have another computer, the addresses where you locate this experiment and the address of your screen RAM might differ, but all our 6502-based machines use the same M.L. instruction set). To enter the monitor, we must SYS to any address in the PET which contains a zero. There is always a zero at address 1024 so we can type SYS 1024 and the PET will display the "registers" and the cursor will land beside a dot, indicating that the monitor is available for our commands.

Let's ignore the register, and simply notice that the fourth number listed is under an "ac" which means that, at this time, the "accumulator" in the 6502 chip contains this number. For a long time, I wondered which addresses in the PET contained the accumulator, the x register and the y register. They are actually unique and not part of the RAM or ROM memory as such. These registers are stopping places for data as it streams from one place to another, from one actual memory cell to another. But on to the experiment.

We will put the letter "A" on the screen. Following the dot, type:

.m 0360 370 (this asks for the numbers between these hex addresses)

Then, when the numbers appear, type in these new numbers right over the ones on the screen:

.0360 A9 41 8D 00 80 00 (we have written a complete action for PET with this, so hit the return key to let the monitor enter these new hex numbers in place of the old ones). If your monitor types a "?" then you have made an error where the "?" appears on the line. Try again.

What have we got here? When the PET is told to start with the instruction A9 it will load the next number in our sequence into the accumulator. That will be the 41. Then it looks at the 8D which tells it that the following two numbers (00 80) are the address to store what is in the accumulator so it puts the 41 at address 8000 (which is hex for the first cell on the screen — and an "A" will appear there. How did 00 80 get changed into 8000? You just have to get used to it. An address is read into the computer LSB (least significant byte) first, followed by the MSB (most significant byte).

The last number we entered was the 00. This is hex for 0, and it is called a "break" which was the way we got into the monitor with our SYS 1024. In this case, when finshed printing our "A", it will come upon our break instruction. Now type: .g 0360 (which means go to 3060 and do what it says there). The "A" will appear and the monitor will come back on showing its registers. Notice what is in the "ac". You can print any other letter by increasing the value where the 41 is. To return to the BASIC mode, type an "x".

This example, so simple, is just how the complex tasks are performed by the computer — one thing at a time (but fast). Organize enough of these segments and you have BASIC, or FORTRAN, or any other "higher" language. Look at the two 00's we used. They represent two different types of numbers which are context-defined in the computer. Since the first 00 followed an instruction (8D) which said put the "A" here, the computer knew that this 00 was the less important part of an address and the next number it found would be the MSB of that same address. Having finished that job, it asks, what next? The next number can *never be an address or a datum.* It must be an instruction to the computer, so the 00 in this position is the instruction "break." A number can only be either a datum, an address, or an instruction. Of these three possibilities, the computer knows how to interpret a number by the "syntax" (the relative position to other numbers in the sequence). This is exactly how we know what someone means when they say "TOO TOO" on the phone, as in "My little girl is two today."

So, our "41" can translate three ways: datum — the actual number (or what that number means in a code, "A" in the ASCII standard translation system); 2. address — the 41st (65th in decimal) address cell in the computer; 3. instruction — please exclusive — or the number located in the cell pointed to by the address in the first 256 bytes as offset by the x register. (Before you are alarmed, there is very little chance that you will ever use this particular instruction with this addressing mode in your entire life.)

M.L. or Assembly Language

What we have just done is the most elemental level of coding next to flipping switches for each bit in each byte. We have entered our code a byte at a time using hex humbers. But this is slow. And, since numbers are so abstract, they are hard to remember. The term "mnemonic" means "memory helper" and this is the next step up. Simple toggle switch or hex programming is usually called "machine level" or "machine language" programming. If you use a three-letter mnemonic instead of A9 to help you remember that this loads the accumulator, things will be easier. LDA means load the "ac", BRK stands for break, and STA means store "ac", and so forth. There are 55 mnemonics, one for each task that our 6502 can perform. However, some of them are so rarely used that you can easily copy down the main ones and learn the strange ones later if you want. Most everything can be done with about 20 of them.

Of course, the computer will not understand

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LDA. It only reads numbers, so you will use a program which lets you enter the LDA, but pokes A9 (actually it hands the PET a decimal number and BASIC takes it down to the binary level for you.) The program which gives BASIC a translation of your LDA is called an **assembler,** hence assembly language or assembly programming. The terms M.L. and assembly language are used interchangeably, though, and both refer to an entry of code in the same way that the computer will later follow it, byte by byte.

Using the M.L. Routines from BASIC

In many cases, you can use a routine in the BASIC code by finding its starting address with a map and then examining it with a disassembler (a program which looks at the raw numbers and translates them back into mnemonics). Then you can just JMP (jump) or JSR (jump to subroutine) from your M.L. program directly into BASIC's M.L. code.

If you are programming in BASIC itself, life is simple, but execution of your program can be too slow. To use our example, if you wanted to print an "A" from BASIC you would type! PRINT "HA" and the computer would put a 41 into the accumulator and jump to 65490 where an all-purpose routine for outputting a byte is located in the BASIC ROM. You could also do this with an M.L. routine by typing: 0360 A9 41 20 D2 FF 00 (The 20 is JSR and the FFD2 is hex for 65490).

But this, too, is slow. After landing in the BASIC ROMs, the first thing that PET does is a jump to another address where it determines that you mean to send the "A" to the screen and not to the tape or a printer. Then it flys down to a "vector" at address 00B0 which is rather like a corner shot in pool — when it gets here it just picks up another address and goes back up into ROM memory pretty close to where it jumped from. And so on. Since BASIC must do all kinds of jobs, it is more general than any routine you program in M.L. yourself. It has to check many parameters before acting to send your "A" to the screen. So, often, you will want to save time and code in M.L. yourself. Using routines from the BASIC ROM also requires that you know what these routines expect as preconditions. That output routine will print whatever is in the accumulator, so you must have loaded it already with the character wanted.

To give another example, you can print a large decimal number to the screen (as in scorekeeping during a game) by a JSR to CF83 (in BASIC 4.0), but you must already have placed the LSB of that number in the X register and the MSB in the accumulator. If you want to experiment with this, go into the monitor and when the registers show on the screen, type over the number in the "ac" and the number in the "xr" with the MSB & LSB of the number you want to have printed. Typing return will change these registers. Then: .0360 20 83 CF 00 .g 0360

What you are doing here is entering BASIC where it prints line numbers on the screen during a LIST, but you are going in and out of that particular area without using any other aspect of that code. Trying to set up this sort of printout would be unnecessary and time-consuming if you tried to do it yourself. So, in this case, we are happy to "borrow" some already programmed M.L. routines from the BASIC ROM.

M.L. or BASIC—Which is best?

Often, BASIC is best. It is easier to program and easier to debug (fix errors). Whole tasks can be left to the computer which you would have to carefully program in M.L. code. And BASIC uses a language which is crypto-English. At least for the beginner, PEEK is easier to relate to than LDA.

M.L. code, when you RUN a program, will often enter never-never-land — an endless loop which you cannot get out of without turning off the computer and destroying the program. There are "warm" resets which you can add to the PET which will exit such a loop and leave your program intact. One helpful technique is to fill the memory area that you are coding with zeros before you start. Then, if something goes awry, you might land on a zero which, as a BRK instruction, will safely send the

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PET into the monitor.

Unless you use a more advanced type of Assembler, which allows you to label addresses and values — it can be hard to keep track of where your subroutines start and which addresses hold which flags, etc. BASIC provides you with the convenience of line numbering, but in simple M.L. assembly, the reference point will be a certain memory address. Obviously it is easier to remember that a subroutine starts on line 1000 than that it starts at 035B. A way around this is to start each routine at a particularly obvious hex number: 0400 0450 0500 0550 0600. In this way, you also avoid another problem which bedevils M.L. programmers: error correction. As you know, if you need to put something in between two lines in BASIC, you merely type in a new line number between them. With M.L., there are no line numbers and no editor to help you make inserts. You might have to recopy dozens of instructions to make room for a new instruction. Leaving space around your routines, however, will avoid this problem.

Another stumbling block for the novice M.L. programmer is addressing. There are often several ways to move data in and around. And, it might take awhile to get them straight in your mind. As always, it is best to practice with a simple task, going through the various "addressing modes" to see the uses and strengths of each one. Most of the books on assembling are weak in this area. For me, the most lucid description of M.L. addressing appears in an article by Jim Butterfield (COMPUTE!, November/December, 1980. Pg. 98).

What You Need to Get Started

You will want a good book with examples which show you how to add, subtract, compare, and loop, etc. in M.L. You need a memory map for your computer's BASIC and a list of the 6502 mnemonics and ASCII equivalents in both decimal and hex. You should have a simple assembler and disassembler. The best bet here is to locate a copy of the "enhanced monitor" program which fits your ROM set. Programs called "Extramon" and "Supermon" are available and they can make things easier. They have commands which will hunt through memory for a designated set of instructions; compare one block with another; fill memory with a particular byte; go through your program one instruction at a time (called **single stepping**) which can be very useful; and relocate your M.L. routines wherever you want them in RAM. All in all, a good BASIC assembler works fine, one of these "enhanced monitors" adds a great deal, and for truly complex assembling, you will want to have full-featured assembler such as MAE (sold by Eastern House Software).

There are several reasons why M.L. code is worth the trouble. It uses very little memory space, it runs very fast (you *must* use it for high-speed tasks such as quality animation or large sorting and disk-access tasks). And, not least, it is challenging and quite satisfying to be working at the level or your machine. You cannot truly say that you understand computers until you know exactly how they "think" — and learning the machine's language is the best way to gain this understanding.

If you have questions, I will be glad to try to answer them if you send a SASE to the address below.

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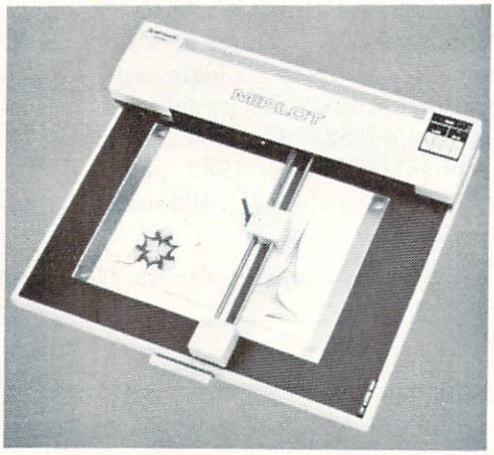

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	I	RELATIVE DRAW	Draw a straight line to the point specified by relative coordinates.
	M	MOVE	Move with pen up to the point specified by absolute coordinates.
	R	RELATIVE MOVE	Move with pen up to the point specified by relative coordinates.
	L	LINE TYPE	Specify solid or broken line.
	B	LINE SCALE	Specify the pitch of a broken line (0.1 – 12.7mm).
	X	AXIS	Draw X or Y coordinate axis.
	H	HOME	Return to the origin with the pen up.
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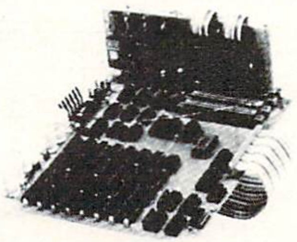

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Computer Communications Experiments

Marvin L. De Jong
Department of Mathematics-Physics
The School of the Ozarks
Pt. Lookout, MO

I. Introduction

This article describes a RS-232C interface circuit for serial input/output that can be used with any computer peripheral that uses such an interface. In this instance, the peripheral is a modem (NOVATION CAT) that can be used to transmit and receive data over telephone lines. Many modems require a RS-232C interface, hence the need for the circuit which in turn uses a 6551 ACIA (Asynchronous Communication Interface Adapter). The purpose of publishing this work is to find one or more persons who would be willing to experiment with computer communications over telephone lines. The article also describes some very simple software that can be used with a modem to transmit and receive messages over telephone lines. Later, more sophisticated load and dump routines can be written to transfer large amounts of data and/or programs from one user to another.

A true confession is that I am a beginner in the area of computer communications, and I would like to try some simple experiments before I fork-up a big subscription fee to one of the networks, only to find that my equipment or my understanding is inadequate. If you can obtain the necessary equipment and if you are in roughly the same position, write me a letter when you have said equipment operating and we will try to arrange a time to try our hardware and software on a telephone link. I might add that the software and hardware described here have *not* been tested, except in the "TEST" mode on my modem, in which case everything worked properly. I am aware that my routines are simple and slow, and I would welcome suggestions for improvement.

II. Circuits And Things

I sometimes wonder if there are any hardware enthusiasts like myself out there. You might let your editor/publisher know of your interests. My hardware fan club seems to be the null set, judging from the amount of mail I get. But here is another circuit even if no one ever builds it. You can always buy an RS-232C interface anyway. The circuit is shown in Figure 1. It consists of three integrated circuits, a 6551 ACIA, a MC1489 RS-232 line receiver, and a MC1483 RS-232 line driver. The latter two circuits change the RS-232 signal levels to TTL levels, and TTL level signals to RS-232 signal levels, respectively. The 6551 ACIA operates at TTL levels (5 volts is logic one, zero volts is logic zero), while the modem operates at RS-232C signal levels (see Michael E. Day's RS232 Communications in COMPUTE!, September/October 1980, page 26). The power connections for the MC1488 and 1489 devices are given in Table 1.

Table 1. Power Connections for the RS-232 line driver and line receiver.

MC1488	Pin 1 = −12V	Pin 14 = +12V	Pin 7 = GND
MC1489	Pin 14 = +5V	Pin 7 = GND	

The connections to the left of the 6551 ACIA are made to the user's microcomputer system. Most of the signals are standard 6502 system bus signals, and require no explanation. Thus, address lines AØ and A1 are used to address the four registers of the 6551, and are connected to the register-select pins RSØ and RS1. (You will probably want to obtain a specification sheet from either Rockwell or Synertek when you get your 6551; in fact, I advise you not to build the circuit without a spec sheet.) The data bus connections are shown in Figure 1, as well as several of the 6502 control lines (R/W, $Ø_2$, $\overline{RES}$, $\overline{IRQ}$). A 1.8432 MHz crystal is also required. Still referring to the connections on the left-hand side of the 6551 in Figure 1, we are left with pins CSØ and CS1, the chip selects.

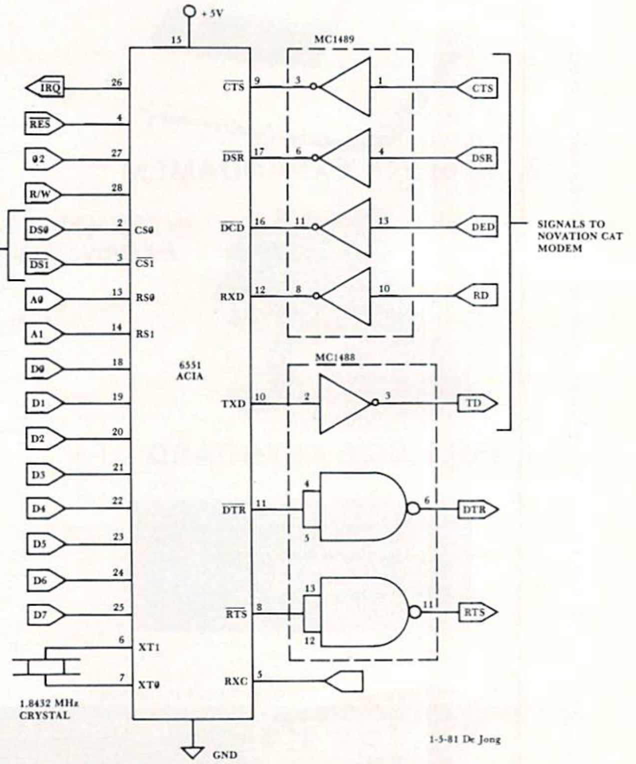

Figure 1. Circuit for the 6502-to-RS-232C-to-Modem interface.

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CRIBBAGE 2.0 (TRS-80 only) — **Price: $14.95 Cassette/$18.95 Diskette**
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This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users.

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MOVING MAZE (Apple only) — **Price: $10.95 Cassette/$14.95 Diskette**
MOVING MAZE employs the games paddles to direct a puck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

BLACK HOLE (Apple only) — **Price: $14.95 Cassette/$18.95 Diskette**
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

TEACHER'S PET I (Available for all computers) — **Price: $ 9.95 Cassette/$13.95 Diskette**
This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

CRYSTALS (ATARI only) — **Price: $ 9.95 Cassette/$13.95 Diskette**
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari.

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NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY — **Price $9.95 Diskette**
DYNACOMP now distributes the 20 + volume NSSE library. Most of these diskettes offer an outstanding value for the purchase price. Write for details regarding the contents of this library and quantity (four or more) purchases.

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DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running under MBASIC.

+ *ATARI, PET, APPLE II, TRS-80, NORTH STAR, CP/M and IBM are registered trade names and/or trademarks.*

BUSINESS and UTILITIES

MAIL LIST II (Apple and North Star diskettes only) — **Price: $24.95**
This many-featured program now includes full alphabetic and zip code sorting as well as file merging. Entries can be retrieved by user-defined code, client name or Zip Code. The printout format allows the use of standard size address labels. Each diskette can store more than 1100 entries (single density North Star or Apple DOS 3.2; over 2200 with double density North Star or Apple DOS 3.3)!

FORM LETTER SYSTEM (FLS) (Apple and North Star diskette only) — **Price: $17.95**
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PERSONAL FINANCE SYSTEM (ATARI only) — **Price: $34.95 Diskette**
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This is a three-in-one program which maintains information accessible by keywords of three types: Personal (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

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COMPARE is a single disk utility software package which compares two BASIC programs and displays the file sizes of the programs in bytes, the lengths in terms of the number of statement lines, and the line numbers at which various listed differences occur. COMPARE permits the user to examine versions of his software to verify which are the more current, and to clearly identify the changes made during development.

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COMPRESS is a single-disk utility program which removes all unnecessary spaces and (optionally) REMark statements from North Star BASIC programs. The source file is processed one line at a time, thus permitting very large programs to be compressed using only a small amount of computer memory. File compressions of 20-50% are commonly achieved.

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FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $44.95 (three cassettes) and $56.95 (three diskettes).

REGRESSION I (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**
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REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $49.95 (three cassettes) or $61.95 (three diskettes).

BASIC SCIENTIFIC SUBROUTINES, Volume I (Not available for ATARI)
DYNACOMP is the exclusive distributor for the software keyed to the text *BASIC Scientific Subroutines, Volume I* by F. Ruckdeschel (see the BYTE/McGraw-Hill advertisement in BYTE magazine, January 1981). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Collection #1: Chapters 2 and 3: Data and function plotting, complex variables
Collection #2: Chapter 4: Matrix and vector operations
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ROOTS (Available for all computers) — **Price $9.95 Cassette/$13.95 Diskette**
In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

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The chip select pins must be controlled by the address decoding circuitry in your microcomputer system, or else you must add your own address decoding circuitry to produce the chip select pulses. Since I have an AIM 65 system, I used one of the device selects available on the expansion connector, namely $\overline{\text{DS9}}$. This signal is active at logic zero for any address in the range $9000 to $9FFF. It was tied to $\overline{\text{CS1}}$, the active-low chip select. If CSØ is tied to +5V, then the registers on the 6551 are selected by any address of the form $9XX0 to $9XX3 where XX is a "don't care" number. Thus, in the programs you will find the four 6551 registers selected by addresses $9400 to $9403. If you have a SYM-1 you can make use of device select $\overline{\text{DS18}}$. If you have an Apple you must provide your own decoding circuitry. The reason lies in the fact that the device select pulses generated by the Apple for the peripheral cards have been logically ANDED with $\emptyset_0$, and consequently they do not become active early enough in either the READ or WRITE cycles to work with 6500 family devices. For a discussion of address decoding see De Jong's [(1)] book. The circuits are generally quite simple. In the case of the Apple, I suggest trying an inverter and a 74133 to generate a device pulse for say $C08X, and perhaps a 74LS245 as a data bus buffer. Try an inverted $\emptyset_1$ to replace $\emptyset_2$. My familiarity with the PET does not justify suggesting any circuits, but I am sure the 6551 can be interfaced to a PET.

We turn next to the signals on the right-hand side of the 6551 as it is shown in Figure 1. The RXC input to the 6551 is the easiest to explain because it is not used in this application. The remaining pins have labels that are almost identical to the RS-232C designations. In fact, the only one that is different is the $\overline{\text{DCD}}$ which is simply CD (Carrier Detect) in RS-232C lingo. Again, refer to references (2) and (3) for a more complete explanation of the RS-232C interface.

Although the signal designations on the 6551 ACIA are almost identical to the RS-232C labels, the signal levels are not, and some arrangement must be made to transform the TTL levels of the 6551 to the RS-232C signal levels. We chose to use integrated circuits designed expressly for that task, namely the 1488 and the 1489 line driver and line receiver. Note that the 1488 requires a positive and negative supply voltage as well as ground. Also, the RS-232C ground (pin 7 on the DB-225 connector) should have the same ground as the 1488 and the 1489. The connections in Figure 1 that are found on the right-hand side of the figure made up a rather complete RS-232C serial interface that may be used to interface to a variety of peripheral devices. Furthermore, the fact that the data format and Baud rate of the 6551 are under the programmer's control makes this an extremely flexible RS-232C interface.

Since computer communication by telephone is the subject of this article, a modem is required. There are a variety of modems with RS-232C interfaces on the market and we do not wish to make any recommendations about them. I purchased a Novation Cat because that appears to be one of the more popular devices. Skyles Electric Works and other advertisers in COMPUTE! offer modems for sale. In any case, my Novation Cat requires the signals designated in Figure 1 in addition to the signal ground. Other modems may require the DTR and RTS signals so we have shown the correct TTL-to-RS-232C interface in the event you may need these signals.

This completes our description of the circuit and we turn next to a simple program that is supposed to allow communication to take place using the 6551 ACIA.

III. A Simple Communications Program

A program that was designed to allow two people to communicate over telephone lines with their computers is given in Listing 1 and a flowchart is shown in Figure 2. This program is very simple and very slow, and it is offered here merely as a way to test the circuit, the program, and the modem. Eventually, one would want to construct more elaborate routines to transfer information quickly. Our interest here is in experimenting for the sake of learning. Hence there is no necessity for encryption devices, bells, whistles or even parity checks.

Here is how it is supposed to work. The caller loads the program and places his modem in the **originate mode** with **full-duplex operation** selected. He loads the indirect jump location with the vector $0F13 so that after the program is begun, his program will go to the transmit loop.

He makes the telephone call to an anxiously awaiting friend who also has this interface and this program operating. The friend has loaded the indirect jump location at $0000 and $0001 with the vector $0F26 (remember, $26 goes in $0000 and $0F goes in $0001). The friend has also placed his modem in the **answer mode** with **full-duplex operation** selected. After an informal chat, both friends put their modems into action by placing the handset into the muffs (assuming acoustic modems). The originator begins to type a message.

He ends his part of the message with an 'EOT' character (Control D on your keyboard). While he is transmitting, the friend's program echoes the message back to the originator where it is read and printed by the computer. It's nice to see what you have said, and to know that it got where it was going with no mistakes. When an 'EOT' character is sent, it automatically transfers the originator's program to the receive loop and the receiver's program to the send loop, giving him a chance to retaliate. Having made no visible symbol to indicate when this changeover takes place, may I suggest sending a

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Listing 1. An Experimental Communications Routine.

```
$0F00 A9 0B     START    LDA #$0B      Initialize the 6551 by loading the
                                       command
 0F02 8D 02 94           STA CMNDRG    register (see 6551 spec sheet for
                                       details).
 0F05 A9 13              LDA #$13      Load the control register for 8-bit
                                       word
 0F07 8D 03 94           STA CNTRG     length and Baud rate of 110.
 0F0A 78                 SEI           Prevent interrupts.
 0F0B D8                 CLD           Clear decimal mode.
 0F0C EA                 NOP           A mistake of mine.
 0F0D AD 01 94           LDA STATUS    Clear any interrupts on the 6551.
 0F10 6C 00 00           JMP (THERE)   Jump to transmit loop to transmit,
                                       receive
 0F13 20 3C E9  TXLOOP   JSR KYBD      loop to receive. Get a character
                                       from the
 0F16 20 F0 0F           JSR TXMIT     keyboard read routine. Send it to
                                       the 6551
 0F19 C9 04              CMP #'EOT'    transmit subroutine. If an "End of
                                       Transmission"
 0F1B F0 09              BEQ RXLOOP    (Control D) is sent, branch to
                                       receive loop.
 0F1D 20 E0 0F           JSR RCVDAT    Get the echo from the receive
                                       subroutine.
 0F20 20 7A E9           JSR OUTPUT    Output it to your own printer to see
                                       what you
 0F23 18                 CLC           sent. Force a jump back to
                                       TXLOOP
 0F24 90 ED              BCC TXLOOP    and get another character to send.
 0F26 20 E0 0F  RXLOOP   JSR RCVDAT    Wait for a character to be sent.
 0F29 C9 04              CMP #'EOT'    Is he finished with his transmis-
                                       sion?
 0F2B F0 E6              BEQ TXLOOP    Yes, then go to transmit loop.
 0F2D 20 F0 0F           JSR TXMIT     Echo the character that was sent.
 0F30 20 7A E9           JSR OUTPUT    Output the character to your
                                       printer.
 0F33 18                 CLC           Force a jump back to RXLOOP
 0F34 90 F0              BCC RXLOOP    and get another character when it is
                                       sent.

Subroutines
 0FE0 AD 01 94  RCVDAT   LDA STATUS    Read the status register to see if a
                                       word
 0FE3 29 08              AND #$08      has been received, otherwise wait
                                       for one.
 0FE5 F0 F9              BEQ RCVDAT
 0FE7 AD 00 94           LDA RCVRG     Get the word from the receiver
                                       register.
0FEA 60                  RTS           Return to the calling program.
 0FF0 48        TXMIT    PHA           Save the accumulator temporarily
 0FF1 AD 01 94  WAIT     LDA STATUS    Is the transmitter register empty?
 0FF4 29 10              AND #$10      No. Wait until it is.
 0FF6 F0 F9              BEQ WAIT
 0FF8 68                 PLA           Get the character from the stack.
 0FF9 8D 00 94           STA TMTRG     Store it in the 6551 transmit
                                       register.
 0FFC 60                 RTS           Return to the calling program.
```

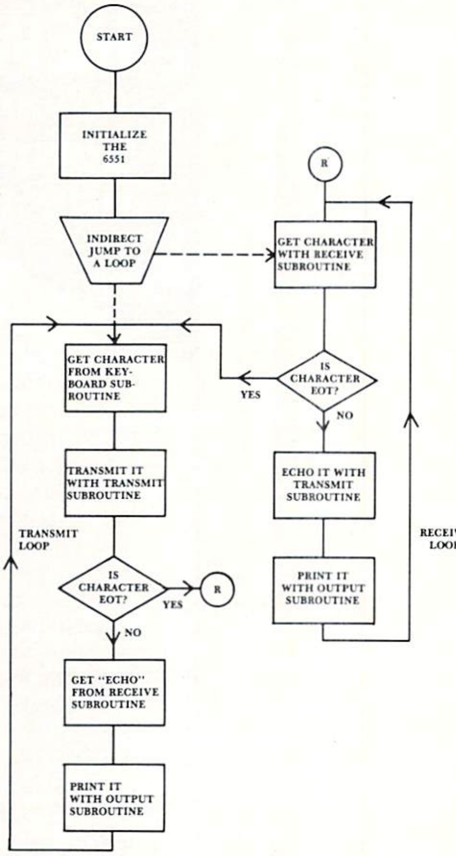

Figure 2. Flowchart of the Transmit/Receive Program. See text for details.

question mark, or perhaps there is some CB lingo that suggests it is the other person's turn to talk. If all else fails, pick up the handset and holler something. *Do not* change your modem from its original answer or originate mode.

So back and forth the conversation goes. Once you have the transmit option in your hands nothing can stop you from talking until you send an 'EOT' and give your friend a chance to say something. Clearly, the program lacks a certain elegance (it may not even work, in which case it lacks a whole lot of elegance), but maybe it will get some fun started. By the way, the originator of the phone call usually gets the phone bill.

Study the flowchart and the program listing. The program begins by intitializing the 6551. An eight-bit word (TTY compatible) is used, with the parity check disabled, and one stop bit is sent. The Baud rate chosen here is 110, but it should be possible to go to 300 Baud. Both participants must have

the same rate. Next, the program jumps to either the receive loop or the transmit loop depending on the vector loaded into $0000 and $0001. This was a crude way to start, but it should work.

In the transmit loop the program first waits for an input from a keyboard read routine. The address in the program belongs to an AIM 65 monitor subroutine that returns the ASCII representation of the depressed key in the accumulator. This character is sent by calling the transmit subroutine which loads the 6551 transmit register with the character. The 6551 takes over and sends the character. The program then waits for the character to be echoed from the other telephone and computer. The echoed character is printed to make sure that what was sent was actually received. Then control returns to the keyboard subroutine to wait for the next character to be sent.

In the receive loop the program jumps to the receive subroutine that watches the 6551 until a character is in the receive data register. If this character is an 'EOT' then control goes back to the transmit loop and you may begin transmitting. Otherwise the received character is immediately echoed back to the sender and also printed with your OUTPUT routine. Again, the address of the OUTPUT routine in Listing 1 belongs to an AIM 65 subroutine. Both the KYBD and OUTPUT subroutines must be supplied by the user's monitor or the user himself, otherwise the program in Listing 1 is complete.

While in the transmit loop, the selection of the 'EOT' character by the sender will automatically transfer control out of the transmit loop into the receive loop. Note again that no bells or whistles have been programmed to occur when you send an 'EOT' character, so if you are transmitting you better let your friend know you are passing control of the system to him.

So hopefully all this will work. If it doesn't you have only me to blame, and I will not assume the cost of your labor or your equipment to conduct this experiment. Perhaps it would be best if you waited until someone else tried it; think it over before you take the plunge.

Besides, my next project is to launch a 6502 Communications Satellite using dynamite in my back yard and you may want to save your money to buy shares in that enterprise.

References

1. De Jong, Marvin L., *Programming & Interfacing the 6502, With Experiments,* Howard W. Sams & Co., Inc. Indianapolis, 1980.

2. Day, Michael E., "RS232 Communications,", *COMPUTE!,* Sept/Oct 1980, 26.

3. Ciarcia, Steve, "I/O Expansion for the TRS-80," *BYTE,* June 1980, 42.

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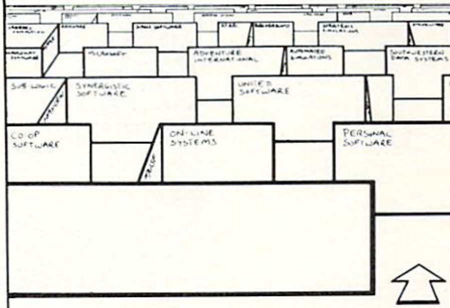

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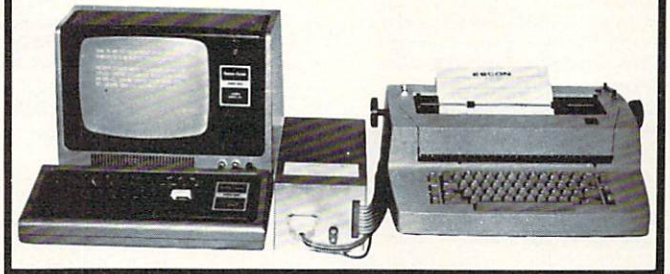

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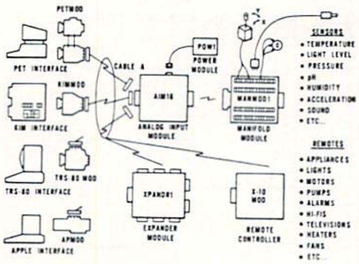
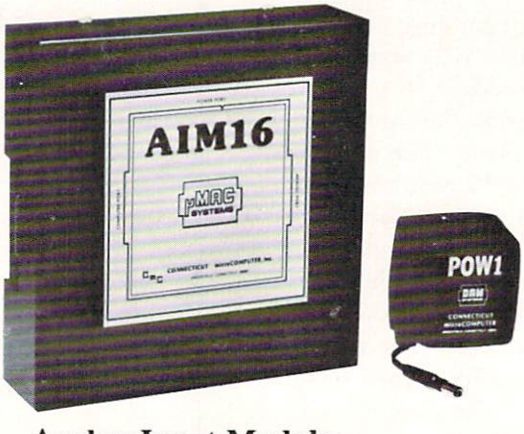
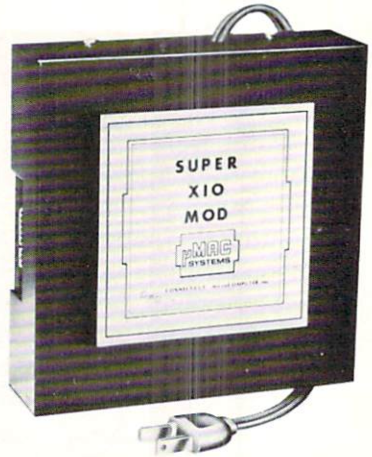






The world we live in is full of variables we want to measure. These include weight, temperature, pressure, humidity, speed and fluid level. These variables are continuous and their values may be represented by a voltage. This voltage is the analog of the physical variable. A device which converts a physical, mechanical or chemical quantity to a voltage is called a sensor.

Computers do not understand voltages: They understand bits. Bits are digital signals. A device which converts voltages to bits is an analog-to-digital converter. Our AIM 16 (Analog Input Module) is a 16 input analog-to-digital converter.

The goal of Connecticut microComputer in designing the uMAC SYSTEMS is to produce easy to use, low cost data acquisition and control modules for small computers. These acquisition and control modules will include digital input sensing (e.g. switches), analog input sensing (e.g. temperature, humidity), digital output control (e.g. lamps, motors, alarms), and analog output control (e.g. X-Y plotters, or oscilloscopes).

Connectors

The AIM 16 requires connections to its input port (analog inputs) and its output port (computer interface). The ICON (Input CONnector) is a 20 pin, solder eyelet, edge connector for connecting inputs to each of the AIM16's 16 channels. The OCON (Output CONnector) is a 20 pin, solder eyelet edge connector for connecting the computer's input and output ports to the AIM16.

The MANMOD1 (MANifold MODule) replaces the ICON. It has screw terminals and barrier strips for all 16 inputs for connecting pots, joysticks, voltage sources, etc.

CABLE A24 (24 inch interconnect cable) has an interface connector on one end and an OCON equivalent on the other. This cable provides connections between the uMACSYSTEMS computer interfaces and the AIM 16 or XPANDR1 and between the XPANDR1 and up to eight AIM 16s.

Analog Input Module .

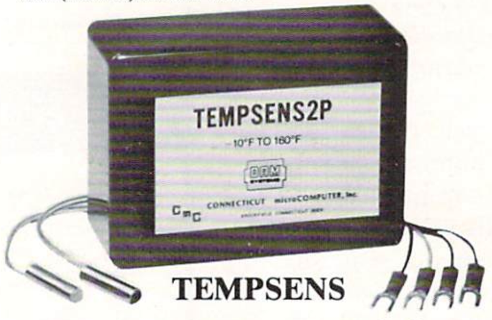
The AIM 16 is a 16 channel analog to digital converter designed to work with most microcomputers. The AIM 16 is connected to the host computer through the computer's 8 bit input port and 8 bit output port, or through one of the uMAC SYSTEMS special interfaces.

The input voltage range is 0 to 5.12 volts. The input voltage is converted to a count between 0 and 255 (00 and FF hex). Resolution is 20 millivolts per count. Accuracy is 0.5% ± 1 bit. Conversion time is less than 100 microseconds per channel. All 16 channels can be scanned in less than 1.5 milliseconds.

Power requirements are 12 volts DC at 60 ma.

POW1

The POW1 is the power module for the AIM16. One POW1 supplies enough power for one AIM16, one MANMOD1, sixteen sensors, one XPANDR1 and one computer interface. The POW1 comes in an American version (POW1a) for 110 VAC and in a European version (POW1e) for 230 VAC.



TEMPSENS

This module provides two temperature probes for use by the AIM16. This module should be used with the MANMOD1 for ease of hookup. The MANMOD1 will support up to 16 probes (eight TEMPSENS modules). Resolution for each probe is 1°F.

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The following modules plug into their respective computers and, when used with a CABLE A24, eliminate the need for custom wiring of the computer interface.

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KIMMOD (KIM,SYM)	39.95
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AIM65 MOD (AIM 65)	39.95

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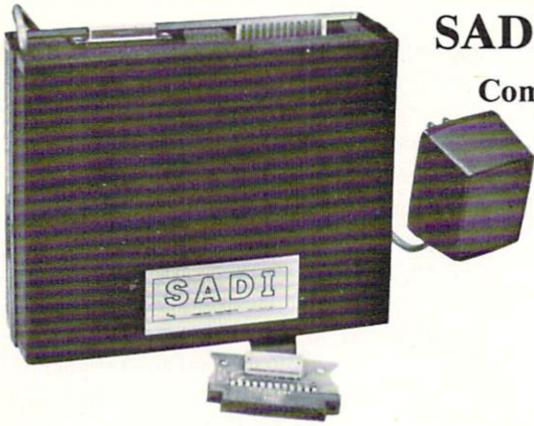

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- Half or full duplex
- 32 character buffer
- X-ON, X-OFF automatically sent
- Selectable carriage return delay

Special Features for the parallel interface include:
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- Device ready - either polarity
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ADA1600 • For Parallel NEC and Centronics Standard Printers

The ADA1600 is a low cost easy to use interface for the Commodore Computers. It allows the PET and CBM computers to use standard Centronics type printers (including the NEC 5530) for improved quality printing. The ADA1600 has a two foot cable which plugs into the PET IEEE port. Another IEEE card edge connector is provided for connecting disks and other peripherals to the PET. The ADA1600 is addressable and does not tie up the bus. The address is switch selectable. A four foot cable with a standard 36 pin Centronics connector is provided. A switch selects upper/lower case, upper/lower case reversed (needed for some Commodore machines) and upper case only for clearer program listings. Works with WORDPRO, BASIC and other software. No special programming is required. The case measures 3 1/2 x 5 3/4 inches. Comes complete, assembled and tested, with case and cables. Power is obtained from the printer or an external power supply may be used. Retail price for the ADA1600 is $129.

ADA1450 • Serial Printer Adapters

The ADA1450 is a low cost, easy to use serial interface for the Commodore Computers. It allows the PET and CBM computers to use standard serial printers for improved quality printing. The ADA1450 has a two foot cable which plugs into the PET IEEE port. Another IEEE card edge connector is provided for connecting disks and other peripherals to the PET. The ADA1450 is addressable and does not tie up the bus. The address is switch selectable. A six foot RS-232 cable is provided with a DB25 connector. Pin 3 is data out. Pins 5,6 and 8 act as ready lines to the printer. Pins 4 and 20 act as ready lines from the printer. These lines can be switched for non-standard printers. Baud rate is selectable to 9600 baud. A switch selects upper/lower case, upper/lower case reversed (needed for some Commodore machines) and upper case only for clearer program listings. Works with WORDPRO, BASIC and other software. No special programming is required. The case measures 3 1/2 x 5 3/4 inches. Comes complete, assembled and tested, with case, cables, power supply and soft' are on cassette for graphing functions, formatting data etc. The ADA1450 has a female DB25 connector at the end of the RS-232 cable for most standard printers. The ADA1450N has a male DB25 at the end of the RS-232 cable for the DIABLO serial printers. Retail price for the ADA1450 or 1450N is $139.

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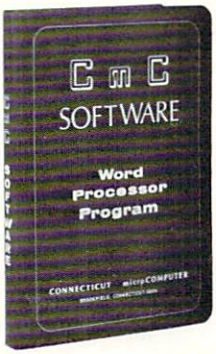

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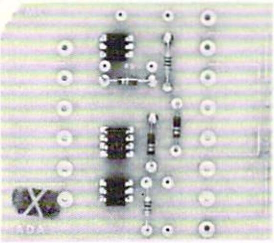

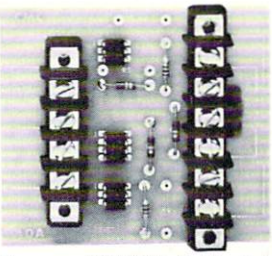

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Basics of Light Pen Operation

Robert A. Peck
Manager, Technical Support to Advanced Manufacturing
Memorex Corporation

Manufacturers of personal computers are attempting to make the computer more easily accessible to the public. In doing so, various means have been tried, such as games, simple home budget programs, and the like. The entry format for each of these had, for the most part, been by means of the keyboard, or a game paddle of some kind.

Just recently, the trend toward light pen "menu" selection for ease of data entry has been tried. Let's look at the actual techniques which could be employed to implement this type of input device on a personal computer. The hardware and software requirements will be discussed here. The reader, after studying these techniques, may be able to construct a working form of a light pen with as little as $5.00 worth of materials.

First a note about the definition of a light pen. It does not emit light... rather it is intended to sense the light of an illuminated area on the TV monitor screen. As a photo-sensitive device, some form of output of the light pen will occur as a result of the electron beam energizing a portion of the phosphor of the screen, thus causing it to glow.

To clarify this a bit further, the picture on a TV screen is not all produced at exactly the same time by a single "photo" flashed on the screen. Instead it is made up of a single electron beam being swept from left to right (and down and up) across the screen, with its intensity varied as it sweeps across the screen, to form the picture we see, one line at a time. In this manner, the sweeping beam produces 30 or 60 complete pictures per second on the TV screen. Our own visual system enables us to perceive the screen as though the entire surface of the screen was continuously lit, thus forming a complete picture. The persistence of the screen, the time it remains bright after the beam has passed a particular location, is minimal for most monitor screens.

Let's act, for the moment, in the same manner that the light pen will act. Imagine, if you will, taking a small cylindrical tube and placing it against the surface of a fully illuminated TV screen. If we place our eyes at the opposite end of this tube, and restrict our vision only to what is at the end of the tube and not to the rest of the screen, we are in a position to make a judgement about what is going on in our narrowly restricted view of the world.

Now we must imagine either that we are able to speed up our ability to perceive rapidly the changing intensity of the light on the area of the screen in front of us or that the beam slows down to our level of perception. Either position is ok for our purposes.

As we are looking into the end of the tube, we will notice that there is no light there most of the time. Specifically the phosphor will only be lit up exactly at the time the beam is striking it, and for a short time thereafter, based on the persistence of the screen. But of course, for the most part, we will be kept in the dark. This will be true at any position on the surface of the screen.

Since we know that we have light for a short time and dark for the rest of the time, it is a yes-no situation and something ideally suited to being handled by the computer. So let's give our eyes a rest and place a lens and a phototransistor within the tube in place of our eye. We know that the phototransistor will produce an output when it sees the light and no output when the light is absent.

...a very simple design will serve most purposes admirably.

How complex must the circuit for the phototransistor be to allow us to make this a useful, reliable device? Well, it depends on the type of selection which we wish to make in the usage of the light pen. We'll soon see that for the largest percentage of potential uses, at least at the hobbyist level, a very simple design will serve most purposes admirably.

In order to grasp the significance of the output/no output capability of the phototransistor, we'll next look at the way the computer or its terminal device is producing the output display which we are seeing on the TV.

Let's say we have a terminal which can display 80 columns by 24 lines of usable character positions on the monitor screen. In the process of output, the scan controller must select, each in turn, line 1 of the character memory, then columns 1, 2, 3, ..., all the way out to column 80. Then it must repeat the line scan for as many TV scan lines a character line is supposed to take up. Then it will go on to the next line of 80 characters, the next, and so forth, going back to the beginning again once all 25 lines have been displayed.

GRAPHICS

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NOW 80 COLUMN PETS CAN HAVE MTU HIGH RESOLUTION GRAPHICS

```
 10 VISMEM: CLEAR
 20 P=160: Q=100
 30 XP=144: XR=1.5*3.1415927
 40 YP=56: YR=1: ZP=64
 50 XF=XR/XP: YF=YP/YR: ZF=XR/ZP
 60 FOR ZI=-Q TO Q-1
 70 IF ZI<-ZP OR ZI>ZP GOTO 150
 80 ZT=ZI*XP/ZP: ZZ=ZI
 90 XL=INT(.5+SQR(XP*XP-ZT*ZT))
100 FOR XI=-XL TO XL
110 XT=SQR(XI*XI+ZT*ZT)*XF: XX=XI
120 YY=(SIN(XT)+.4*SIN(3*XT))*YF
130 GOSUB 170
140 NEXT XI
150 NEXT ZI
160 STOP
170 X1=XX+ZZ+P
180 Y1=YY-ZZ+Q
190 GMODE 1: MOVE X1,Y1: WRPIX
200 IF Y1=0 GOTO 220
210 GMODE 2: LINE X1,Y1-1,X1,0
220 RETURN
```

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From this, you can see that the scan controller will be continuously fetching characters from the character memory. Thus the different addresses of the different characters will each be available on the address bus of the scan controller at the time that character is being fetched for output.

To put it another way, if our character memory was set up such that line 1 position 1 represented address 0 of the character memory and line 1 position 80 represented character address 79, line 2 position 1 as address 80 and line 25 position 80 as address 1999, we would then have a specific point of reference to use. We now take our light pen and place it on the screen directly over one specific character position which is, let us say, occupied by a single solid block character such as a nonblinking cursor.

Every time the phototransistor sees a light output on the screen, at the exact time it occurs, the scan controller address bus has, on it, the exact address within the scan memory occupied by the character which is producing the light output on the screen.

Just as an example of what this address would mean to us, consider the following example. Suppose that at screen location 400 (first position in line 6) we place a cursor character followed by the description .. "CHECKBOOK BALANCER" and at location 800 in the scan memory we placed another cursor character labeled "TREK", we can place the light pen over the cursor character representing the specific program which we wish to have called in next and will expect the light pen scan program to provide us with the data required to do it. In this case when the light pen senses an output, the address of either position 400 or 800 will be on the scan position address bus, ready to be picked up for use by our program. We know that if our program finds 400 on the bus, it must next call in the Checkbook Program. Conversely, if it finds 800 on the bus, it must retrieve the Startrek Program.

Now if we wanted to do so, we would add some additional hardware to our terminal which would act, in association with the phototransistor output, to capture the address present on the bus at the time a light output is sensed. As an exercise, let's examine some of the hardware this would require.

First we need something to capture the scan address from the controller bus and a way to transfer it to the data bus of the computer. A set of three 74175's could be used here. Each is a 4-bit tri-state latch, where the input (capture side) would be connected to the scan memory data bus and the output (storage side) would be connected to the computer data bus for later retrieval. The control lines for the latches would have to be connected in some manner to the light pen through a flip-flop of some kind to assure only a single sampling of the address from the scan counter per application of the light pen to the screen. The tri-state control lines would be connected to the address decoders of the computer so that it could retrieve any one of the three 4-bit stored parts of the scan address after it was triggered.

The best features of this technique are the simplicity of the software required and the non-critical nature of the components of the light pen...

It might, at first glance, seem a pretty straightforward approach to follow, but let's look at a few of the drawbacks. The first would be the critical control of the level of light intensity sensed by the pen. Specifically, it could possibly be accidentally triggered either by an outside source of light, or by the phosphor persistance (as little as there is) when we first place the pen against the surface of the screen. In either case, the address we sense on the scan control bus does not really represent the actual address of the sample point we are trying to isolate. This might entail some special circuitry to be added to sense only the rising edge of the beam light intensity, where that rising edge has a specific rise time, and therefore not trigger on an outside incandescent light source operating on a 60 Hz sine wave.

To complicate matters further, even though we succeeded in developing this type of edge sensitive equipment, we still run into some problems with fluorescent light sources in the area, in that these have a very fast rise time and have a phosphor afterglow as well. Both items make the light from the fluorescent vary in a manner similar to that of the TV screen. Our software could, of course, compensate for this, but combined with the hardware requirements, we have selected a really complex task. One more area of difficulty, just to mention it here, is the inability to accurately sense the difference in address locations between two adjacent, or very nearly adjacent, squares on the screen unless special circuitry is added for the rise-edge, as described above.

Fortunately, there is a way to absolutely minimize the amount of circuitry needed to establish a workable light pen, along with a way to minimize the complexity of the software which has to go along with it. In addition, the pen needs only to accept a source of power and ground from the computer, and will need only a single bit input port to operate fully. Some manufacturers suggest the use of the same paddle input for the light pen. Below is described the technique which can accomplish this form of operation.

The best features of this technique are the simplicity of the software required and the non-critical nature of the components of the light pen, as

SORT is a 6502 machine language in-memory sorting algorithm of commercial quality for PET and APPLE owners. Most sorts are accomplished in less than a second and large sorts take only a few seconds. The algorithm is a diminishing increment insertion sort, with optionally chosen increments. There are no conditions under which SORT performance degenerates or fails.

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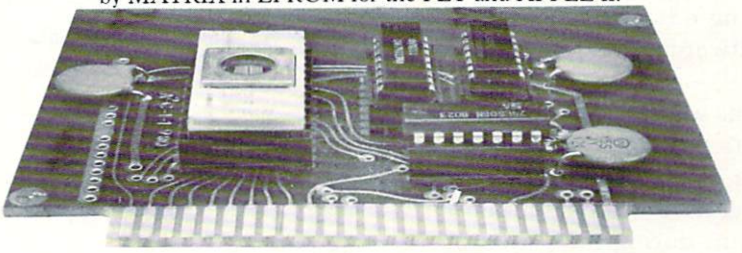

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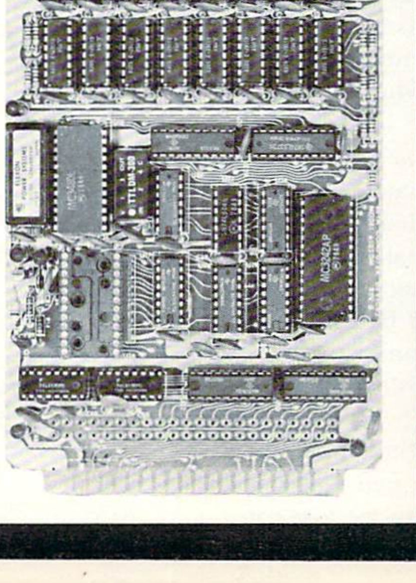

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well as the non-critical nature of the level adjustments required. We also have an easy way of compensating for any external light source which may have an effect on the pen, and actually ignore it. Let's examine this technique now.

First, let us attack the problem of light sensitivity adjustment. It is proposed that, for this method we will work with, the pen need only be able to distinguish between the presence or absence of illumination within a selected square on the screen. If we are working within a range of light or no light, you can see that we will have a wide degree of adjustment available and still allow the pen to operate perfectly well.

With the original example, let's say we had placed a menu selection box at both scan memory locations 400 and 800 and assume also we are using the simple-form light pen which plugs into the game paddle input. Instead of using a hardware-based scan technique, we will use a software based scan as follows.

Assume for example that we have placed the pen over the square at scan location 800 and we begin our scan. Both the square at 400 and at 800 appear illuminated at this time. Therefore if the light pen is pointing to either one of them, during the period of time of the sweep of the beam across the screen, the light pen will put out a series of pulses coincident with the presence of the beam in the area occupied by the pen.

Now we can begin our scan by replacing the selector box at scan memory location 400 with a blank space (no output on the screen at this point). We will then go to the light pen input and stay in a loop for about 1/60 or 1/30 second and find out if, during that loop, there were any light pulses output. If there were still output light pulses, it means that we had not turned off the square over which the light pen is resting now, so we must continue the scan. Then we relight the square at location 400 and proceed to replace the square at 800 with a blank space. We will again loop through the test program area to determine if there have been any light pulse outputs during the time that location 800 was turned off. If no outputs were sensed during this time, we know we have found the correct location where the light pen is sitting.

We can then take the address we have found this way and use it to control which action is to be done next, just as in the previous hardware controlled case, but here with a good deal less complexity. You can also see that we may have many many menu boxes on the screen and by this means accurately determine exactly which one is being addressed by the light pen. After all, we are the one who is controlling whether the light pen can see a light output from a specific square. So if we turn off a square, and then see that the light pen no longer has an output, we know which square we just controlled and therfore we know what the required operation will be.

We have then substituted a software scan technique for both the complex hardware and complex software the other approach would have required. The primary limit in the number of menu boxes we can use is the amount of time which would be required, at 1/60 or 1/30 sec per box, for the light-pulse-present scan per box on screen. If we have no concern for the time this takes, then there is little reason to limit the number of boxes on the screen except to keep them far enough apart so that the light pen will see the light output from only one at a time, maintaining the wide range of light sensitivity we discussed earlier.

...thus far we have substituted a software scan for the set of complex hardware.

Speaking of light sensitivity, let's discuss the way we'd handle an outside light source and ignore its influence in our selection of the item to be performed. First, a reminder that the single spot on the TV screen we are monitoring is dark for most of the time and is lit by sweeps of the beam only as it passes the area we are monitoring. Now if we consider the outside source of light, it will rather seen to be a continuous sequence of pulses (fluorescent) or a continuous single light level. In the event that there is some continuous pulse interference, we must adjust our software to test that there are no more than X (let's say 50) pulses which occur during a single sweep through our software scan subroutine. This would allow us to ignore such interference as is caused by either a fluorescent or an incandescent source. Certain types of light, such as the sun, cannot be distinguished by the pen as a wave, so are translated as a continuous level, thereby resulting in nearly zero (perhaps one) transitions during the time of a single scan. Thus, we decide that unless greater than one and less than 50 pen state transitions have occurred in one scan, we could probably assume that the visible part of the screen scan probably had been triggered by an outside source, and we can enter into some type of wait state, scanning the pen itself for a time when the correct number of transitions is sensed and, within the wait state loop, also scan our keyboard and any other alternate input device which may be connected to the system and intended for use with the particular program as an input.

A final note about outside light sources; when we have the pen up against the screen, the major influence on the pen will be the light from the screen alone. In this position, the pen will not be affected very much by the outside light.

So thus far we have substituted a software scan for the set of complex hardware. We have used a technique which requires very little translation of address sensed into work to be done. We could probably go into the type of construction required for the light pen itself.

But wait, there seems to be some griping from the back of the room. Yes ... Oh ... OK! The gentleman in the last row says "That's ok for you guys who have the Visible Memory (direct access) display screens, but how about the rest of us who only have the scrolling type of screen?"

A fair question, I agree. All right. A scrolling type of screen is one where everything moves up one notch to make room for the bottom line once the screen is filled. Well, a number of these types of screens have the ability to move the cursor in a relative manner or an absolute manner. If it does have this capability, then the technique still works exactly the same way...we just have to work a little harder. Lets look at a quick example.

We'll print a cursor box followed by a descriptive line on the screen, followed by a blank line, and repeat this for 5 selections. Now to do the cursor scan, we will begin from the lower left (home) cursor position and move-relative-cursor until we get to the position occupied by one of the selector boxes. Then we replace it with a blank space instead. Scan. Are there light pulses present? If not, we've found the light pen position. If so, cursor backspace, put back the selector box, space relative cursor to the next selector box and repeat the process. As you can see, there is no basic change in the procedure, just a slightly different approach.

Sir,...you do have relative cursor?! Ok then, at least we've got one satisfied customer. By the way, you'd probably be interested; the terminal I use on my machine is a scrolling type and thats why I was prepared for that question!

Now for the construction of the light pen itself. We'll need some kind of small cylinder to house it. The cylinder will have to have enough room for the phototransistor itself. And, it should have some room for a small variable resistor and a voltage comparator IC if we want to have it fully self-contained and ready to plug into the game paddle input of our computer.

I have provided a sketch of the proposed construction of the pen, along with the schematic of the one I use. These parts I had were primarily junk-box components, and as a result, my total cost was about $1.00 (plus the software development time). You could probably obtain most of the components for $5.00 or less.

Well, best of luck with your construction and testing. If you develop some interesting applications for your light pen, I would appreciate the chance to hear about them:

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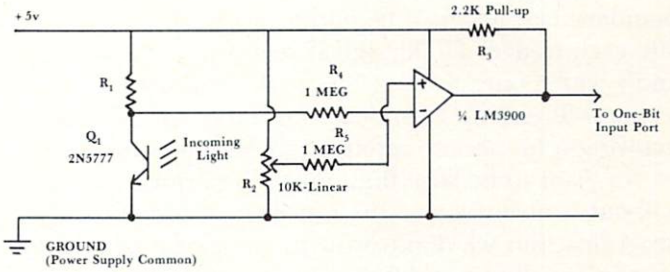

Fig. 1. Basic Inexpensive Light Sensor

Q_1 Mounted in Tip of Pen

R_2 Sensitivity adjustment, adjusted so that plus pulses are present while pen is on screen opposite a part of screen which is lit up.

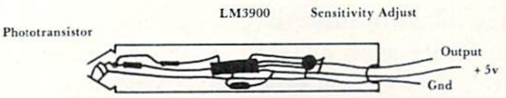

Fig. 2. Typical Construction

ABOUT THE AUTHOR: Bob has a BSEE from Marquette University and an MBA in Finance and Economics from Northwestern. He has been involved with computers since 1965, and has taught microcomputer courses for Cogswell College in Sunnyvale, CA. He has authored three booklets on hardware and software for the 6502-based SYM-1 Single-Board computer. His assignment at Memorex involves arranging a smooth transition for new products from development engineering to Manufacturing. ©

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Getting The Most From Your Pet Cassette Deck

Editor's Note: There's much of value here for any cassette user, regardless of machine type. A couple of asides — the new recorders from Commodore (the VIC version) have tape counters. The second point is simply a comment on Mr. Sander's remark regarding mail-order computer store tapes... most are quite reliable in business practice and quality control. RCL.

Louis F. Sander
Pittsburgh, PA

PET owners not fortunate enough to own a disk spend many minutes, and ultimately many hours, waiting for the cassette deck to finish its work. SEARCHING seems to take forever, and we never know whether the search will finish with a READY, or with the dreaded ?LOAD ERROR. This article gives some practical advice on making that waiting time shorter, more productive, and less filled with anxiety. It is oriented toward the novice, and it contains much that has been explained before, although never to our knowledge all in one place. But even the most experienced PLAY presser should find something of value in it. We begin with a treatise on tape buying, proceed to information on recorder care and useful accessories, and end with a compendium of helpful hints for the recordist, librarian and programmer.

What Should You Feed A PET?

Standard cassettes can be had at prices from under 50¢ each to over $5.00, and it seems impossible to know which ones to buy. Since the typical PET owner will end up with dozens of tapes in his library, knowing a bit about cassettes can be quite important — we want to be sure that ours will perform reliably, without contributing to the loss or ruin of valuable programs, but we don't want to pay extra for quality we can't really use. (After all, most of us are saving up for that disk system.) A careful study will show that there are three main areas of difference among cassettes, each of which we'll discuss here: playing time, mechanical construction, and type of magnetic tape.

First, playing time. Every cassette is marked with a number such as C-30, C-60, C-90, etc. The digits after the 'C' tell how many total minutes of playing time there are on *both sides* of the tape. A C-30, for example, has two 15-minute sides, for a total of 30. Even though the longer tapes cost very little more than the short ones, for most PET owners the C-30 is the longest one to buy. One side of a C-30 will hold at least six long (8K) programs, and can be fully rewound in about 60 seconds. A C-60 will hold twice as many programs, but it gets tedious to search through all that tape to find the one you're looking for; the rewind time is longer, too. The C-90's and above tend to be made with very thin tape that likes to break, or to let data leak through from one side of the tape to the other, either of which can ruin your program and your day. Probably the *best* size is the C-10, which is not widely available, but which holds one or two programs on a side, and which nicely minimizes search time.

Cassette construction is less obvious than the other two factors, but it does bear some discussion. Cassette housings range from sloppily molded boxes to finely assembled mechanisms with bearings and other anti-friction devices. Most housings are glued together, but some are assembled with screws. Many experienced PET users prefer the screw type, which can be taken apart for emergency untangling of tapes. (That can be a big factor when the fouled tape has your latest masterpiece on it.) Sloppy construction is most often found in off-brand discount store cassettes, and it should be avoided, since a sloppy housing tends to let the tape escape and be mangled by your recorder. In general, the more expensive cassettes have better housings, and are easier to rewind or fast forward, but you should have little trouble with any but the very poorest housings.

The finest and most expensive magnetic tape has a chromium dioxide (CrO_2) coating, and should *not* be used in the PET. It requires special circuitry that the PET doesn't have, and its greater abrasiveness can cause rapid wear to tape-handling parts. The next step down is extra-quality tape with a ferric oxide coating, usually selling for $2.50 -$5.00 or more per cassette; this tape is designed to give a very wide frequency response in stereo recording and playback. It will work fine in the PET's monophonic recorder, but its premium quality doesn't add much to performance, and for many people the extra quality is not worth the extra price. The same can be said of the "certified" computer cassettes in this price range. Your PET doesn't need "computer quality" tape, or leaderless tape, so why pay extra for it?

Further down the line is garden-variety ferric oxide tape with a well-known audio or electronics brand, usually sold for under $2, or much less in multi-packs. For most PET owners, this is the best combination of price and performance. The tape is designed for monophonic recorders like the PET's, and it has the uniform quality usually found in well-known brands of any product. The widely available Radio Shack Concertape, starting at 3/$1.99, is a good example of this kind of tape. Also in this price range are the cassettes sold by mail-order computer stores that cater to PET owners. There are some real advantages to these cassettes — the price is right, they are available in the convenient C-10 size, and they are usually screw-assembled. But there can be risks, too. Some mail-order computer stores are

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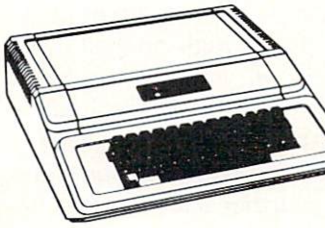

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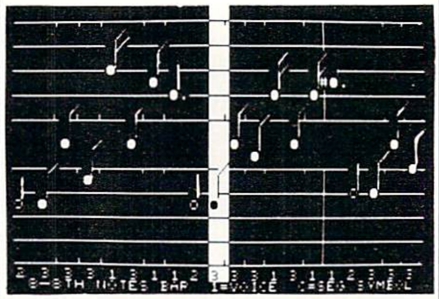

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shaky operations with flaky quality control and fluky business practices. A good policy with these tapes is to try them if it suits you, but keep a close eye on what you get.

At the bottom of the list are the tapes you should avoid — the ones sold in discount stores, with brands you never heard of in audio or electronics. These are not much cheaper than Concertapes, and the tape inside is sometimes uneven and dirty. For most of us, the risk of getting junk is not worth the savings, so we should stick with something better.

Looking Out For Tape #1

Every tape head needs periodic maintenance, and the two on your PET are no exception. Experts recommend cleaning and demagnetizing tape heads after every ten hours of use, and you do yourself a big favor by following their advice. If you neglect these important tasks, sooner or later you'll begin to notice frequent LOAD ERROR messages, and you may permanently damage every recording you pass by the head. Tape head tolerances are measured in micro-inches, and it's very common for an invisible buildup of oxide residues to cause major signal losses, often leading to LOAD ERRORs. It's also common for recording heads to become magnetized after a period of use, especially if the recorder power is cut while doing a SAVE. A magnetized head partially erases every tape that is run past it. A dirty head can scratch tapes. Remember, a good head session takes only about 1010_2 minutes, and it clears your head for another $ØA_6$ hours of use, so it's well worth the effort.

To start your maintenance program, get a bottle or spray can of tape head cleaner and a package of swabs. It's helpful, too, to get a small angled mirror, so you can inspect the heads while you work on them. Also get a head demagnetizer, of the type that plugs into the wall. (The cleaners and demagnetizers that look like cassettes are not as effective as the other types, and some poor ones can actually damage your head, so we suggest that you avoid them.) All these items can be purchased, often in kit form for under $20.00, at any good audio or electronics store. Sometimes you can borrow them from a friend who's into stereo or home computers.

When maintenance time comes, follow the instructions that come with the cleaner, and thoroughly swab the heads, tape guides, capstan and pinch roller, all of which you can get to by unplugging the PET and depressing the PLAY control. If you can't identify which parts to clean, any knowledgeable stereo salesman can show you the corresponding parts on his equipment, and that should be enough to get you started. Next, demagnetize the heads, meticulously following the instructions that come with your demagnetizer. Particularly avoid cutting power to the demagnetizer when it is anywhere close to a head, or you may magnetize it yourself. Keep your tapes at least 5 - 6 feet away from the demagnetizer at all times, or you may accidentally erase them. Remember that magnetic fields pass easily through everything but steel, and that a wooden desk drawer can hide tapes from you, but not from your demagger.

Useful Tape Accessories

The most useful tape accessory is a second recorder, but *not* the kind that plugs into the Second Cassette Port. You will gain many enjoyable minutes by using an extra recorder of any kind to search or rewind one tape while LOADing another. When searching, just play the tape until you hear the high-pitched leader tone, and start it right there on your PET. The buzzsaw sound after the leader tone is the actual program material. If your extra recorder has a tape counter, you can use it to keep track of program locations on the tape, and further lessen your SEARCHING time. If it has the Cue/Review feature, you can listen to the recorded material while rewinding or fast forwarding, which is also very helpful in finding things. If your recorder has a built-in microphone, make or buy a short-circuited plug to fit the MIC jack and cut out the microphone; that will let you erase selected areas on your tapes, which is useful if you're recording over other material and getting a lot of VERIFY ERRORs. Without the built-in mike, you don't need the shorting plug.

The extra recorder, used in audio mode, can help you type in programs from COMPUTE! and other sources, too. Just read the program aloud into the microphone, carefully enunciating every comma and semicolon, then play it back to yourself and type in the program as you hear it. This is a super method for proofreading programs that don't work.

Another useful accessory is a bulk eraser, for quickly erasing tapes when you want to re-use them. Mine is a Nortronics Sound-Off, a permanent magnet unit that works by just sliding the cassette through a slot. Most of them plug into the wall, and work like head demagnetizers, but on a grander scale. Be careful with bulk erasers — they create a strong magnetic field that can erase your good tapes if they are anywhere close by.

The stores have many other items you might find worthwhile. Radio Shack has a slick manual rewinder. The Sams book "Tape Recording for the Hobbyist" and the Nortronics "Recorder Care Manual" are good sources of useful information. Advanced tape hobbyists may also like to have a tape splicer and a head alignment tape, but these are beyond the needs of most of us.

Tape Handling Tips

1. Running new tapes back and forth a few times before using them will minimize binding and breakage. Erasing tapes before re-use will minimize read errors due to "junk" on the tape. Breaking out

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the write protect tabs on a cassette will keep you from writing over programs by mistake. Covering the write protect hole with tape will override the protection.

2. Keep your tapes clean: Rewind cassettes before putting them aside, and never touch the magnetic tape itself. Always use plastic cassette boxes; the soft ones are cheaper and tougher, but the hard ones are prettier. (I use hard boxes for master tapes and soft ones for working copies.) Keep your cassette boxes in metal containers; stray magnetic fields are everywhere, especially around motors and transformers, and they can damage unprotected tapes.

3. As soon as you SAVE a program, label the cassette with the program name. Half-inch masking tape makes an easily removable label for cassettes, and also fits perfectly on the edge of hard or soft cassette boxes. Half-inch Scotch Magic Tape makes a neatly erasable label for the same places.

4. A 1K program takes about 35 seconds to SAVE, VERIFY, or LOAD. A 4K program takes about 90 seconds, and an 8K program about 150 seconds, or 2½ minutes. The practice of SAVEing each program twice on the same tape will keep you happy in the face of minor malfunctions; the practice of keeping master copies on a separate tape in a separate room will keep you happy in the face of disaster.

5. There is a small but real danger of write-through when programs are recorded on both sides of one piece of tape. You can avoid it by using only one side of your cassette, or by using both sides and recording no further than mid-tape. I usually SAVE one program twice on each side of a C-10. That way I have minimal search and rewind time, conveniently located second copies of each program, and no overlapping.

6. During program development, SAVE your work frequently, so you'll have something to work with after an unanticipated NEW or system crash. To keep track of the different versions, make the date and time of the SAVE an integral part of your program's working name: "02141015SPACEWAR" fits into the 16-character limit, and indicates that this version of SPACEWAR was SAVEd on 2/14 at 10:15 AM. If there's ever a question, it will be obvious that "02141300SPACEWAR" is a later version, and that "01312200SPACEWAR" is an earlier one.

That's the end of one user's notes on saving time and grief with your PET's tape deck. There must be many other good ideas on the subject. If you have some, let us know about them.

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Part 3 of several

The Mysterious And Unpredictable RND

Bob Albrecht and
George Firedrake

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Editor's Note: You may reach Bob & George by mail at: P.O. Box 310 Menlo Park, CA 94025

Dice Roller

OK PET, let's roll one die a bunch of times. We will simulate rolling an ordinary six-sided die. For each roll, the possible outcomes are 1 or 2 or 3 or 4 or 5 or 6.

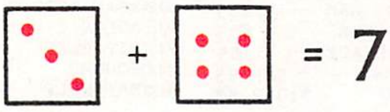
```
1ØØ REM****DICE ROLLER #1

2ØØ REM****FIND OUT HOW MANY ROLLS
21Ø PRINT "[CLR]" ;
22Ø INPUT "HOW MANY DICE ROLLS" ; N

4ØØ REM****ROLL ONE DIE N TIMES
41Ø FOR K = 1 TO N
42Ø    DIE = INT(6*RND(1)) + 1
43Ø    PRINT DIE,
44Ø NEXT K
45Ø PRINT

999 END
```

For many dice games or other uses of dice, we roll *two* dice. The outcome of a roll is the total of the "spots" or number showing on both dice.



Your turn. Tell PET how to simulate rolling two dice.

Exercise 11. Write a program to simulate rolling two dice, N times.

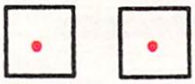
```
HOW MANY DICE ROLLS? 2Ø

8         7         3         1Ø
9         9         8         4
6         7         1Ø        11
5         6         5         6

READY
■
```

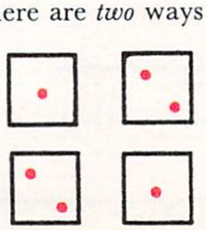
When we roll two dice, the possible outcomes are numbers from 2 to 12. However, they are *not* equally likely.

- There is only *one* way to get 2.



1 + 1 = 2

- There are *two* ways to get 3.



1 + 2 = 3

2 + 1 = 3

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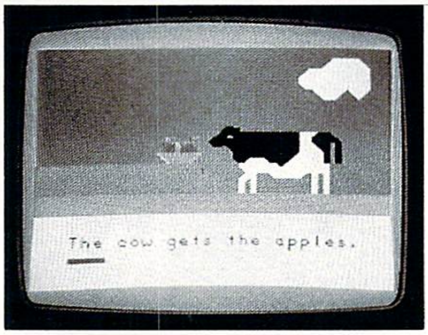

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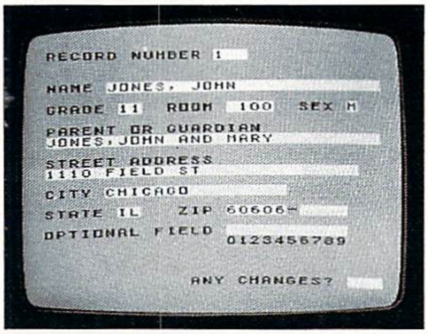

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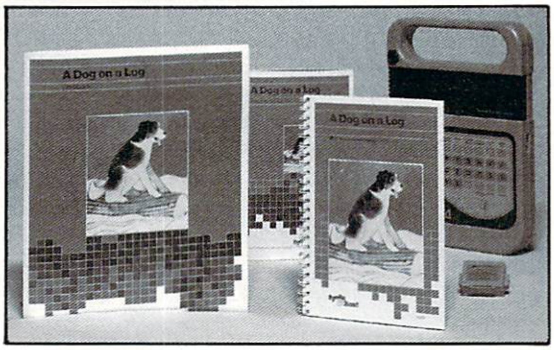

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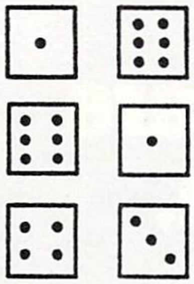
- There are several ways to get 7.



1 + 6 = 7

6 + 1 = 7

4 + 3 = 7

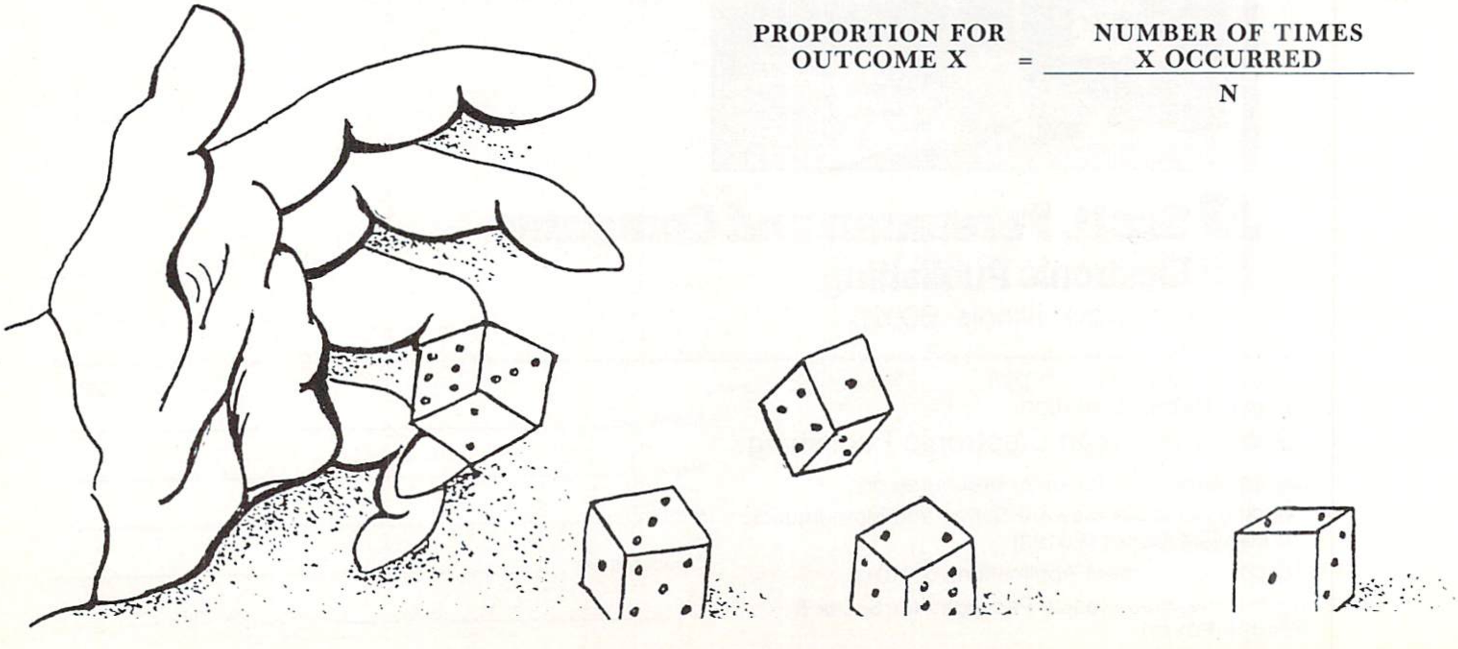
And several more!

Exercise 12. Complete the following table showing the number of different ways to get each *possible* outcome (2 through 12) in rolling two 6-sided dice.

OUTCOME	NUMBER OF WAYS
2	1
3	2
4	5
5	—
6	—
7	—
8	—
9	—
10	—
11	—
12	—

Next, we would like to compute proportions, as defined below (X is any outcome, 2 through 12).

$$\text{PROPORTION FOR OUTCOME} = \frac{\text{NUMBER OF WAYS TO GET OUTCOME X}}{\text{TOTAL NUMBER OF WAYS FOR ALL OUTCOMES}}$$



Or, since the total for all outcomes is 36,

$$\text{PROPORTION FOR OUTCOME X} = \frac{\text{NUMBER OF WAYS TO GET OUTCOME X}}{36}$$

Exercise 13. Complete the following table (use a calculator!)

OUTCOME	NUMBER OF WAYS	PROPORTION
2	1	1/36 = .0278
3	2	2/36 = .0556
4	3	3/36 = .0833
5	—	______
6	—	______
7	—	______
8	—	______
9	—	______
10	—	______
11	—	______
12	—	______

If we flip a coin, the *probability* of getting HEADS is ½ = .5. What is the *probability of getting TAILS?*

Yes, we are leading up to a heavy exercise. But, you can probably do it!

Exercise 14. Write a program to simulate N rolls of two dice. Don't print the results. Instead, count the number of occurrences of each possible outcome (2 through 12), then print this information *and* also print the proportion of each outcome. Huh? For N rolls, the proportion for outcome X is:

$$\text{PROPORTION FOR OUTCOME X} = \frac{\text{NUMBER OF TIMES X OCCURRED}}{N}$$

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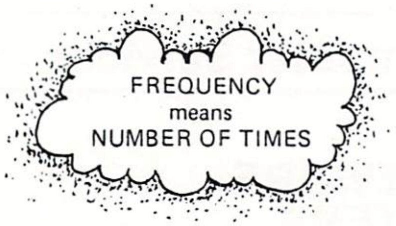
We did it, we wrote the program and ran it. Here is what happened.




```
OUTCOME  FREQUENCY  PROPORTION

  2         23        .Ø24
  3         62        .Ø62
  4         81        .Ø81
  5         1Ø9       .1Ø9
  6         14Ø       .14
  7         142       .142
  8         137       .137
 99         126       .126
  1Ø        8Ø        .Ø8
  11        72        .Ø72
  12        27        .Ø27
```

If you have the time, try 10000 rolls, or 20000 rolls, or even 100000 rolls. Compare the proportions with the proportions you wrote down for Exercise 13. Or, compare with our answers for Exercise 13. ©

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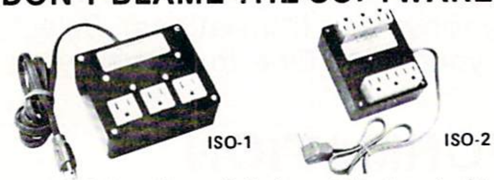

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For those using disk drives, the programs have been coherently grouped and are available on diskettes. The price of each diskette is $180 which represents a considerable savings with regard to the individual cassette price.

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M4 **Calculus I Diskette** - contains 726 - 737.

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33. pH Concept
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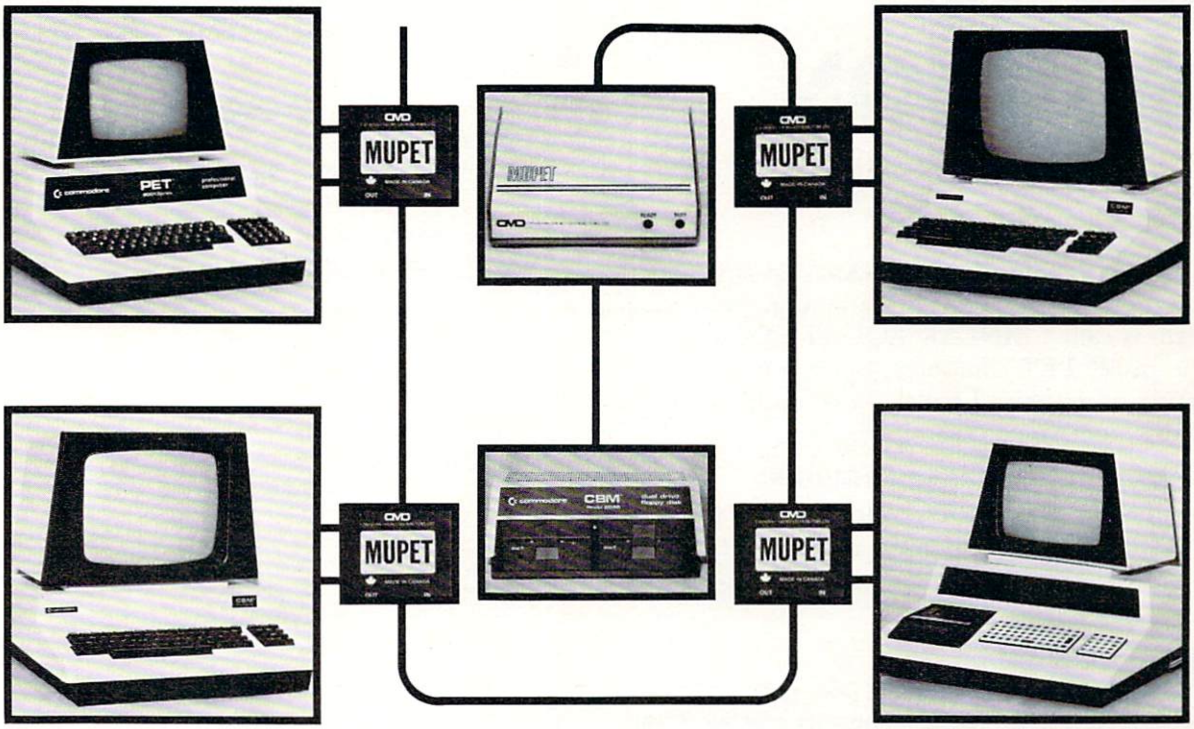

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A CAI program called LINEAR EQUATION

Peter Oakes
Muskegon, MI

This article is about Computer-Assisted-Instruction or commonly called CAI programming. My example program is called LINEAR EQUATION. It is written for an 8K PET computer. Since it uses a minimum of graphics I believe it could be modified for many other small computers.

The Program Has These Features:

choice of using the computer monitor or a printer.
choice of 6 different randomly generated problems.
problem solutions complete with step by step procedures for solving.

Program Description

Lines 100-106 simply announces the program.

Line 108 makes the RND (random number generator) truly random for the "older" original ROM PETs.

Lines 110-122 asks if the user wants to use a printer. If this option is executed, then the problem question and solution (and procedure) will be written to the printer. Everything else is still done on the monitor. Figure 1 shows a sample output for a printer. Of course, a similar output would appear on the monitor if the printer option is not executed.

Lines 124-144 ask for the problem type the user wants generated. Line 144 forces the user to answer only with a 1,2,3,4,5,or 6. A similar control occurs in line 118 making sure the user answers with Y,N, or T.

Lines 146-168 gets the random data to generate the problems. Line 152 generates a random number V(I) in the range [-11.0 to +11.0] excluding [-0.9 to +0.9]

Lines 158-168 calculate specific problem data. Example: X1 = <u>INT</u>(-V(2)/V(1)*<u>100 + .5)/100</u> calculates the x-intercept of a line rounded off to hundredths by the underlined portion of the statement.

Line 172 opens the PET to a device (ie: opens to write to the monitor or printer depending on the value of U8 from lines 114-116). Line 172 also clears the monitor if the printer is not used. Line 174 prints a "divider" between problems if a printer is used. Line 176 will GOTO the printing of the selected problem as does line 250 print the appropriate solution.

Lines 234-250 checks (on the monitor) to see if a solution is wanted.

Note that in the printing of signs care has been taken to print the appropriate - or + sign. An example is found in the subroutine at lines 402-406 (as used from line 264). If T had a value of -7.2, then the subroutine would make T$ be -7.2 whereas if T had a value of 7.2, then T$ would be made +7.2 which assures the correct printing of T$.

The rest of the program lines are unique to what each line does and would take too much space to explain every detail. I'll let the reader read those lines over on his own. I hope this program will be of value to the reader as CAI programs can be very helpful in mathematics. Figure 2 shows a complete listing of the program with graphics noted.

Figure 1

```
=====================================

GIVEN: SLOPE = 9.2
       Y-INTERCEPT ( 0,-5.6 )

FIND:  AX+BY+C=0 WITH B=-1
ALSO:  X-INTERCEPT.




USING:  Y - Y1 = M(X - X1)
WHERE   M = SLOPE OF THE LINE
        (X1,Y1) = A POINT ON THE LINE

THEN   Y + 5.6 =  9.2 ( X - 0 )
       Y + 5.6 =  9.2 X
       0 =  9.2 X - Y - 5.6  (EQUATION)



IF Y=0:  0 =  9.2 X - 0 - 5.6
         0 =  9.2 X - 5.6
        -9.2 X = -5.6
         X =  .61

THUS     ( .61 , 0 ) = X-INTERCEPT
```

Figure 2

```
100 PRINT"ĥLINEAR EQUATION":PRINT"PETER ¬
    ¬OAKES,10-1-80,7K
102 PRINT:PRINT"PROGRAM GENERATES ¬
    ¬LINEAR EQUATION
104 PRINT"PROBLEMS AND PROVIDES A ¬
    ¬SOLUTION
106 PRINT"PROCEDURE.
107 :
108 U9=RND(-TI):REM RANDOMIZE RND
109 :
110 :REM USE PRINTER ?
112 PRINT:INPUT"USE PRINTER (Y,N,T)";Q$:
    ¬IFQ$="T"GOTO388
114 IFQ$="Y"THENU8=4:GOTO120
116 IFQ$="N"THENU8=3:GOTO126
118 GOSUB392:GOTO112
120 PRINT:PRINT"WHEN PRINTER IS READY - ¬
    ¬PRESS ṟSPACEȓ KEY
122 GETQ$:IFQ$=""GOTO122
123 :
124 :REM PROB CHOICE
126 PRINT"ĥWANT TO SOLVE A LINEAR ¬
    ¬EQUATION GIVEN
128 PRINT" 1. SLOPE & Y INTERCEPT
130 PRINT" 2. SLOPE & A POINT
```

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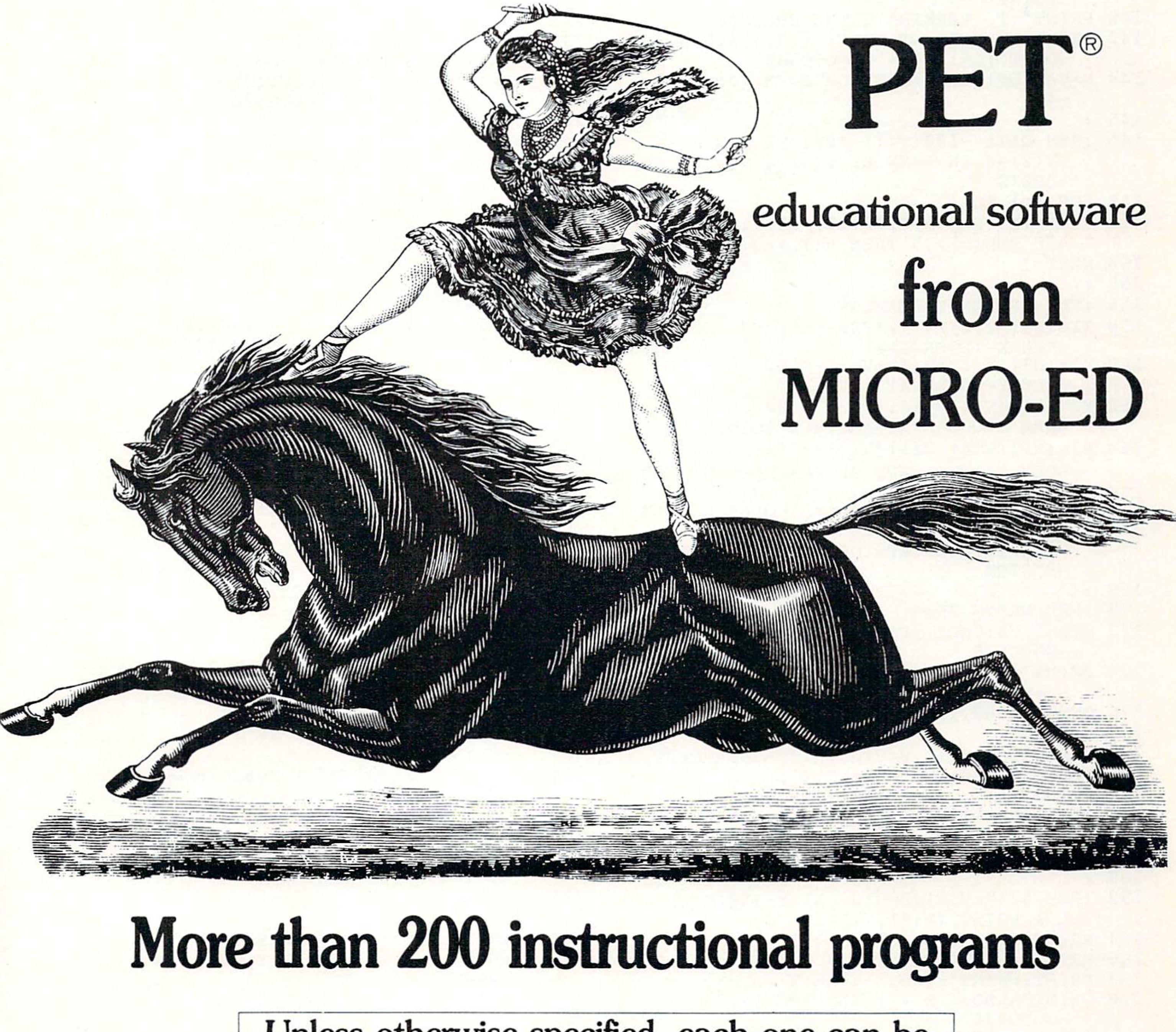

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```
132 PRINT" 3. TWO POINTS
134 PRINT" 4. X & Y INTERCEPTS
136 PRINT" 5. PARALLEL LINE & A POINT
138 PRINT" 6. PERPENDICULAR LINE & A ¬
    ¬POINT
140 PRINT" T. TERMINATE THE PROGRAM
142 PRINT:INPUT"WANT TYPE: 1,2,3,4,5,6,
    ¬OR T";Q$:IFQ$="T"GOTO388
144 N=VAL(Q$):IFN<1ORN>6ORINT(N)<>NGOTO1
    ¬42
145 :
146 :REM DATA -1ØØ<V(I)<1ØØ; V(1)=M & ¬
    ¬V(2)=B IN Y=MX+B; V(3) & V(4)=X-CO
    ¬ORD'S
148 FOR I=1 TO 4
152 V(I)=INT(RND(1)*1ØØ+.5)/1Ø+1:
    ¬IF RND(1)>.5 THEN V(I)=-V(I)
154 NEXT I
155 :
156 :REM ASSIGN VARIABLES
158 X1=INT(-V(2)/V(1)*1ØØ+.5)/1ØØ:
    ¬REM X-INTERCEPT
16Ø Y1=INT((V(1)*V(3)+V(2))*1ØØ+.5)/1ØØ:
    ¬REM Y-COORD AT A POINT
162 Y2=INT((V(1)*V(4)+V(2))*1ØØ+.5)/1ØØ:
    ¬REM Y-COORD AT ANOTHER POINT
164 B1=INT((V(4)-V(1)*V(3))*1E2+.5)/1E2:
    ¬REM Y-INTERCEPT OF PARALLEL SYSTEM
166 M2=INT((-1/V(1))*1ØØ+.5)/1ØØ:
    ¬REM SLOPE FOR PERPENDICULAR SYSTEM
168 B2=INT((V(4)-M2*V(3))*1ØØ+.5)/1ØØ:
    ¬REM Y-INTERCEPT OF PERPENDICULAR ¬
    ¬SYSTEM
169 :
17Ø :REM WRITE PROB
172 OPEN1,U8:CMD1:IFU8=3THENPRINT"ĥ":
    ¬GOTO176
174 PRINT"==============================
    ¬=========
176 ONNGOTO18Ø,194,2Ø6,216,226,232
177 :
18Ø :REM #1:M=V(1),B=V(2),X1=X-INTERCEPT
182 PRINT"GIVEN: SLOPE = "V(1)
184 PRINT"        Y-INTERCEPT ( Ø,"V(2)")
186 PRINT:PRINT"FIND:  AX+BY+C=Ø WITH ¬
    ¬B=-1
188 PRINT"ALSO:  X-INTERCEPT.":GOTO236
189 :
192 :REM #2:M=V(1),B=V(2),X1=X-INTERCEPT
    ¬ & POINT (V(3),Y1)
194 PRINT"GIVEN: SLOPE = "V(1)
196 PRINT"       F("V(3)") = "Y1
198 PRINT:PRINT"FIND:  Y=MX+B
2ØØ PRINT"ALSO:  X & Y INTERCEPTS.":
    ¬GOTO236
2Ø1 :
2Ø4 :REM #3:M=V(1),B=V(2) & POINTS:
    ¬ (V(3),Y1) & (V(4),Y2)
2Ø6 PRINT"GIVEN THE POINTS:  ("V(3)",
    ¬"Y1")
2Ø8 PRINT"                    ("V(4)",
    ¬"Y2")
21Ø PRINT:PRINT"FIND:  Y=MX+B":GOTO236
212 :
214 :REM #4:M=V(1),B=V(2),X1=X-INTERCEPT
216 PRINT"GIVEN: Y-INTERCEPT ( Ø,"V(2)")
218 PRINT"       X-INTERCEPT ("X1",Ø )
22Ø PRINT:PRINT"FIND:  Y=MX+B":GOTO236
222 :
224 :REM #5:M=V(1),B=V(2) & POINT:
    ¬ (V(3),V(4))
226 M$="PARALLEL":GOSUB432:GOTO236
228 :
23Ø :REM #6:M=V(1),B=V(2) & POINT:
    ¬ (V(3),V(4))
232 M$="PERPENDICULAR":GOSUB432
233 :
234 :REM WANT SOLUTION ?
236 PRINT:PRINT:PRINT#1:CLOSE1
238 PRINT:INPUT"WANT SOLUTION (Y,N,
    ¬T)";Q$:IFQ$="T"GOTO388
24Ø IFQ$="Y"GOTO246
242 IFQ$="N"GOTO378
244 GOSUB392:GOTO238
245 :
246 :REM WRITE SOLUTION
248 OPEN1,U8:CMD1:IFU8=3THENPRINT"ĥ
25Ø ONNGOTO254,276,294,318,34Ø,356
251 :
252 :REM #1
254 GOSUB41Ø
256 PRINT:PRINT"THEN  Y ";:T=V(2):
    ¬GOSUB398:PRINT T$" = "V(1)"( X - ¬
    ¬Ø )
258 PRINT"        Y "T$" = "V(1)"X
26Ø PRINT"        Ø = "V(1)"X - Y ";:
    ¬T=V(2):GOSUB4Ø4:PRINT T$;
262 PRINT"  (EQUATION)":PRINT:PRINT
264 PRINT:PRINT"IF Y=Ø:  Ø = "V(1)"X - ¬
    ¬Ø ";:T=V(2):GOSUB4Ø4:PRINT T$
266 PRINT"           Ø = "V(1)"X "T$
268 PRINT"          ";-V(1)"X = "V(2)
27Ø PRINT"           X = "X1
272 PRINT:PRINT"THUS        ("X1", Ø ) = ¬
    ¬X-INTERCEPT":GOTO376
273 :
274 :REM #2
276 GOSUB41Ø:PRINT
278 T=Y1:M=V(1):GOSUB418
28Ø PRINT:PRINT:PRINT"IF X=Ø:  Y = ¬
    ¬"V(1)"(Ø) "T$" = "T$
282 PRINT"           ( Ø ,"T$") = ¬
    ¬Y-INTERCEPT
284 PRINT:PRINT:PRINT"IF Y=Ø:  Ø = ¬
    ¬"V(1)"X "T$
286 PRINT"          ";T" = "V(1)"X
288 PRINT"          "X1" =  X
29Ø PRINT"          ("X1", Ø ) = ¬
    ¬X-INTERCEPT":GOTO376
291 :
292 :REM #3
294 PRINT"SLOPE = M = (Y1-Y2)/(X1-X2)
296 PRINT"        = ("Y1;:T=Y2:GOSUB398:
    ¬PRINT T$")/("V(3);
298 T=V(4):GOSUB398:PRINT T$")
3ØØ PRINT"        = "V(1)
3Ø2 PRINT:PRINT"THUS IN THE EQUATION:
    ¬  Y =   MX  +  B
3Ø4 PRINT"                      Y = ¬
    ¬"V(1)"X + B
3Ø6 PRINT:PRINT:PRINT"THEN  "Y2" = ¬
    ¬"V(1)"("V(4)") + B
3Ø8 PRINT"          "Y2" = ";INT((V(1)*V(4))
    ¬*1ØØ+.5)/1ØØ;" + B
31Ø PRINT"          "V(2)" =  B
312 PRINT:PRINT:PRINT"THUS THE EQUATION ¬
    ¬IS
314 PRINT:PRINT"       Y = "V(1)"X ";:
    ¬T=V(2):GOSUB4Ø4:PRINT T$:GOTO376
315 :
316 :REM #4
318 PRINT"USING:  Y = MX + B
```

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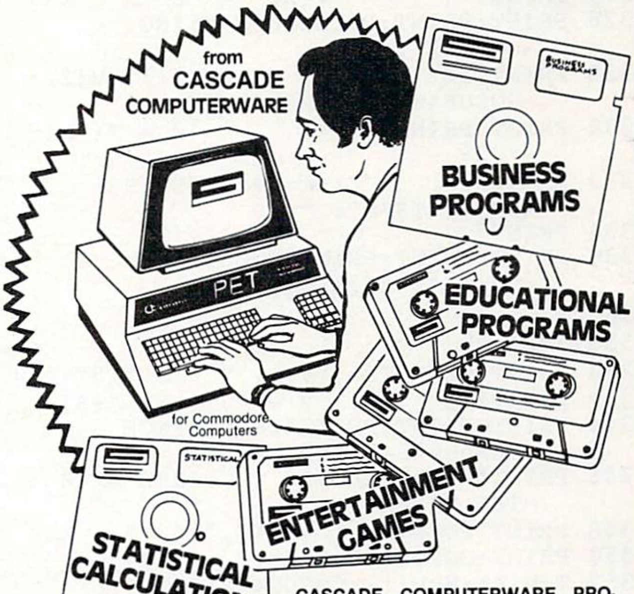

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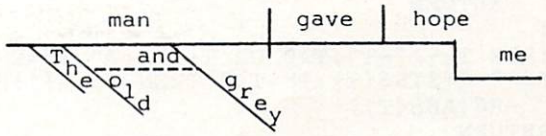

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```
320 PRINT"AND       ( 0  ,"V(2)")
322 PRINT:PRINT"THEN      "V(2)" = M(0) + ¬
     ¬B
324 PRINT"             "V(2)" =  B
326 PRINT:PRINT:PRINT"NOW USING:
     ¬  ("X1", 0 )
328 PRINT"IN             Y = MX";:T=V(2):
     ¬GOSUB404:V2$=T$:PRINT V2$
330 PRINT:PRINT"               0 = M("X1") ¬
     ¬"V2$
332 PRINT"            ";:T=X1:GOSUB398:
     ¬PRINT T$"M = "V2$
334 PRINT"             M = "V(1)
336 PRINT:PRINT:PRINT"EQUATION:    Y = ¬
     ¬"V(1)"X "V2$:GOTO376
337 :
338 :REM #5
340 PRINT"REWRITE  "V(1)"X - Y "T$" = 0
342 PRINT"AS          Y = "V(1)"X "T$
344 PRINT:PRINT:PRINT"THEN SINCE ¬
     ¬PARALLEL LINES HAVE
346 PRINT"EQUAL SLOPES TOGETHER WITH ¬
     ¬THE GIVEN
348 PRINT"POINT:  ("V(3)","V(4)")   AND
350 PRINT:GOSUB410:PRINT
352 T=V(4):M=V(1):GOSUB418:GOTO376
353 :
354 :REM #6
356 PRINT"REWRITE  "V(1)"X - Y "T$" = 0
358 PRINT"AS          Y = "V(1)"X "T$
360 PRINT:PRINT:PRINT"THEN SINCE ¬
     ¬PERPENDICULAR LINES HAVE
362 PRINT"SLOPES THAT ARE NEGATIVE ¬
     ¬RECIPROCALS
364 PRINT"THEN M = -1/("V(1)") = "M2
366 PRINT:PRINT"THUS TOGETHER WITH THE ¬
     ¬GIVEN
368 PRINT"POINT:  ("V(3)","V(4)")   AND
370 PRINT:GOSUB410:PRINT
372 T=V(4):M=M2:GOSUB418
373 :
374 :REM ANOTHER PROB ?
376 PRINT:PRINT:PRINT#1:CLOSE1
378 PRINT:INPUT"ANOTHER PROBLEM (Y,
     ¬N)";Q$:IFQ$="N"GOTO388
380 IFQ$="Y"GOTO384
382 PRINT:GOSUB394:GOTO378
384 IFU8=3THENPRINT"ĥ
386 GOTO124
388 END
389 :
390 :REM SUBROUTINES
391 :REM USE (Y,N,T)
392 PRINT:PRINT"USE T TO TERMINATE THE ¬
     ¬PROGRAM OR"
394 PRINT"USE Y FOR YES OR N FOR NO!":
     ¬RETURN
395 :
396 :REM T-->"-T",T>0 OR T-->"+T",T<=0
398 T$="-"+STR$(T):IF T<0 THEN T$="+"+ST
     ¬R$(ABS(T))
400 RETURN
401 :
402 :REM T-->"+T",T>0 OR T-->"-T",T<=0
404 T$="+"+STR$(T):IF T<0 THEN T$="-"+ST
     ¬R$(ABS(T))
406 RETURN
407 :
408 :REM PROB HEADER
410 PRINT"USING:  Y - Y1 = M(X - X1)
412 PRINT"WHERE   M = SLOPE OF THE LINE
414 PRINT"          (X1,Y1) = A POINT ON ¬
     ¬THE LINE":RETURN
415 :
416 :REM WRITE SOLUTION
418 PRINT"           Y ";:T1=T:GOSUB398:
     ¬Y1$=T$:PRINT Y1$" = "M"( X ";
420 T=V(3):GOSUB398:PRINT T$" )
422 PRINT"           Y "Y1$" = "M"X ";:
     ¬T=INT(M*V(3)*100+.5)/100:GOSUB398
424 PRINT T$
426 PRINT:PRINT"           Y = "M"X ";:
     ¬T=INT((-T1+T)*100+.5)/100:GOSUB398
428 PRINT T$"  (EQUATION)":RETURN
429 :
430 :REM WRITE PROB
432 PRINT"FIND:  Y=MX+B THAT IS "M$" TO
434 PRINT:PRINT"          "V(1)"X - Y ";:
     ¬T=V(2):GOSUB404:PRINT T$" = 0
436 PRINT:PRINT"          CONTAINING  ¬
     ¬("V(3)","V(4)")":RETURN
```


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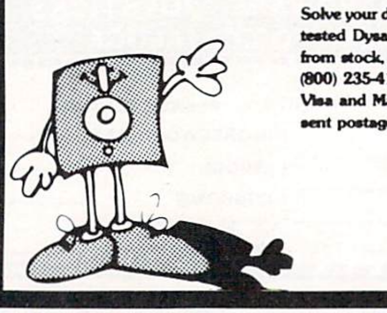

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Sample Execution

```
=========================================
GIVEN:  SLOPE = -1.6
        Y-INTERCEPT ( 0,-7.9 )

FIND:   AX+BY+C=0 WITH B=-1
ALSO:   X-INTERCEPT.

USING:  Y - Y1 = M(X - X1)
WHERE   M = SLOPE OF THE LINE
        (X1,Y1) = A POINT ON THE LINE

THEN  Y + 7.9 = -1.6 ( X - 0 )
      Y + 7.9 = -1.6 X
      0 = -1.6 X - Y - 7.9  (EQUATION)

IF Y=0:  0 = -1.6 X - 0 - 7.9
         0 = -1.6 X - 7.9
         1.6 X = -7.9
         X = -4.94

THUS     (-4.94 , 0 ) = X-INTERCEPT
```

```
=========================================
GIVEN:  SLOPE =  10.3
        F( 1.8 ) =  17.04

FIND:   Y=MX+B
ALSO:   X & Y INTERCEPTS.

USING:  Y - Y1 = M(X - X1)
WHERE   M = SLOPE OF THE LINE
        (X1,Y1) = A POINT ON THE LINE

        Y - 17.04 =  10.3 ( X - 1.8 )
        Y - 17.04 =  10.3 X - 18.54

        Y =  10.3 X - 1.5  (EQUATION)

IF X=0:  Y =  10.3 (0) - 1.5 = - 1.5
         ( 0 ,- 1.5) = Y-INTERCEPT

IF Y=0:  0 =  10.3 X - 1.5
          1.5  =  10.3 X
          .15  =  X
          ( .15 , 0 ) = X-INTERCEPT
```

```
=========================================
GIVEN THE POINTS:  ( 1.2 , 12.62 )
                   (-2.9 ,-10.34 )

FIND:  Y=MX+B

SLOPE = M = (Y1-Y2)/(X1-X2)
      = ( 12.62 + 10.34)/( 1.2 + 2.9)
      =  5.6

THUS IN THE EQUATION:  Y =   MX  +  B
                       Y =  5.6 X + B

THEN  -10.34  =  5.6 (-2.9 ) + B
      -10.34  = -16.24  + B
       5.9  =  B

THUS THE EQUATION IS

       Y =  5.6 X + 5.9
```

```
=========================================
GIVEN:  Y-INTERCEPT ( 0,-10.6 )
        X-INTERCEPT ( 7.07 ,0 )

FIND:  Y=MX+B

USING:  Y = MX + B
AND      ( 0 ,-10.6 )

THEN     -10.6  = M(0) + B
         -10.6  =  B

NOW USING:  ( 7.07 , 0 )
IN           Y = MX- 10.6

              0 = M( 7.07 ) - 10.6
         - 7.07M = - 10.6
              M =  1.5

EQUATION:   Y =  1.5 X - 10.6
```

```
=========================================
FIND:  Y=MX+B THAT IS PARALLEL TO

          1.9 X - Y - 8.9 = 0

       CONTAINING  (-2.6 ,-5 )

REWRITE  1.9 X - Y - 8.9 = 0
AS         Y =  1.9 X - 8.9

THEN SINCE PARALLEL LINES HAVE
EQUAL SLOPES TOGETHER WITH THE GIVEN
POINT:  (-2.6 ,-5 )  AND

USING:  Y - Y1 = M(X - X1)
WHERE   M = SLOPE OF THE LINE
        (X1,Y1) = A POINT ON THE LINE

        Y + 5 =  1.9 ( X + 2.6 )
        Y + 5 =  1.9 X + 4.94

        Y =  1.9 X - .06  (EQUATION)
```

```
=========================================
FIND:  Y=MX+B THAT IS PERPENDICULAR TO

          -6.1 X - Y + 5.1 = 0

       CONTAINING  ( 2.1 , 6.8 )

REWRITE  -6.1 X - Y + 5.1 = 0
AS         Y = -6.1 X + 5.1

THEN SINCE PERPENDICULAR LINES HAVE
SLOPES THAT ARE NEGATIVE RECIPROCALS
THEN M = -1/(-6.1 ) =  .16

THUS TOGETHER WITH THE GIVEN
POINT:  ( 2.1 , 6.8 )  AND

USING:  Y - Y1 = M(X - X1)
WHERE   M = SLOPE OF THE LINE
        (X1,Y1) = A POINT ON THE LINE

        Y - 6.8 =  .16 ( X - 2.1 )
        Y - 6.8 =  .16 X - .34

        Y =  .16 X + 6.46  (EQUATION)
```

Hex Conversion

Using The 6502's Decimal Mode

Jack Clarke

Since the advent of 8 bit microprocessors, the hexidecimal numbering system has been around to help provide a shorthand notation for binary numbers... remember 4 binary bits can be expressed with just 1 hexadecimal character? (F = 1111_2)

While this shorthand notation has revolutionized Assembly Language coding, undoubtedly many a new computerist has cursed the notation as problematical, confusing and cumbersome.

To assist the programmer (old and new), elaborate tables have been generated to convert the *radix* of a number from one base to another... remember radix and base are synonymous? To further the cause of this translation, numerous programs have been written in higher level languages. Take a look at Texas Instrument's hand-held "Programmer" which has gained a commendable respect in the programming community. Have you ever tried to poke or peek with your Apple without one of the above?

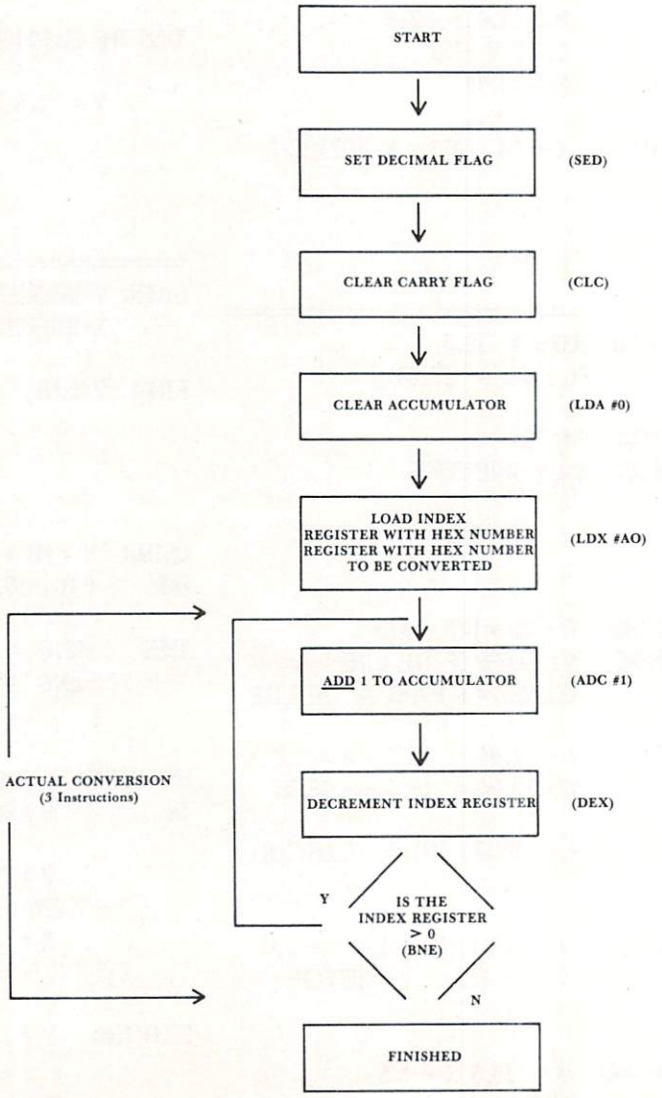
What is this decimal mode you ask? Simply defined it is a clever bit of binary manipulation that is performed inside the microprocessor to insure that when you add, a "1" to a "9" that the result is "Ø with carry" and not "A", (also known as BCD coding). In other words, 4 binary bits can express a decimal number 0 thru 9, (10 thru 15 is illegal). So an eight bit number provides numbering 0 thru 99.

Now, let's take a closer look at the 6502's instruction set and see how the *decimal* mode can help with this numbering conversion.

A "bit" of examination reveals that the decimal mode *only* works when performing an add (ADC) or subtract (SBC) instruction. All other instructions simply ignore the decimal mode. Take for example the increment/decrement instruction. It performs an addition or subtraction (by one) but always in the binary/hex mode. Now, what would happen if we combined a decrement/increment instruction with an add/subtract instruction. The increment instruction would count up one in hexadecimal while the add instruction would simultaneously count up in decimal... did I just see a hex to decimal conversion go by?

How about an example? Suppose you wish to convert the hex number "A0" to the equivalent decimal number. (Don't pull out your conversion tables yet). Follow the flow chart in Figure 1 and walk through the steps. First set the decimal mode (SED), clear the accumulator (LDA Ø IMM) and clear the carry flag (CLC). Next, load the x-register with the hex number to be converted (LDX A0 IMM). Now, the conversion starts. Decrement the x-register (DEX) and test for zero (BNE). If the x-register is >0 then add 1 to the accumulator (ADC 1 IMM). Repeat the sequence until the x-register has counted down to 0. When you examine the contents of the accumulator you will find the *decimal* equivalent of "A0" sitting there quietly. If you need a hex equivalent of a decimal number you would enter the decimal number in the accumulator and *subtract* one in the decimal mode... each time you subtract you would also increment the x-register. See any similarities?

For numbers greater than 99 you would perform the addition or subtraction using two or more memory locations and keep track of the carry flag, (double precision arithmetic). The X and Y registers could also be cascaded for extended range with 16 bits. Conversion of 0000 thru FFFF could be easily implemented.



Hex To Decimal Conversion

The best way to familiarize yourself with this type of approach is to try it on your own computer. After gaining a little confidence in the ease of the conversion, you will soon find the same techniques incredibly helpful in more complex operations such as multiplication and division. Take the example of a program that is sampling the rate of an asynchronous input... By knowing the "sample time" of your program (each time you read the port) and adding that *constant* instead of "1" you effectively convert and multiply in one operation resulting in a decimal formatted "total number of samples"

To summarize the concept of radix conversion using the 6502's decimal mode, start with zero in the accumulator and index register and add "1" to the accumulator (decimal mode) and increment the index register at the same time. You will observe the accumulator counting up in decimal and the index register counting up in binary/hex.

Say good-bye to those dog-eared tables and long involved conversion programs that you have been using. The 6502 takes another bow. ©

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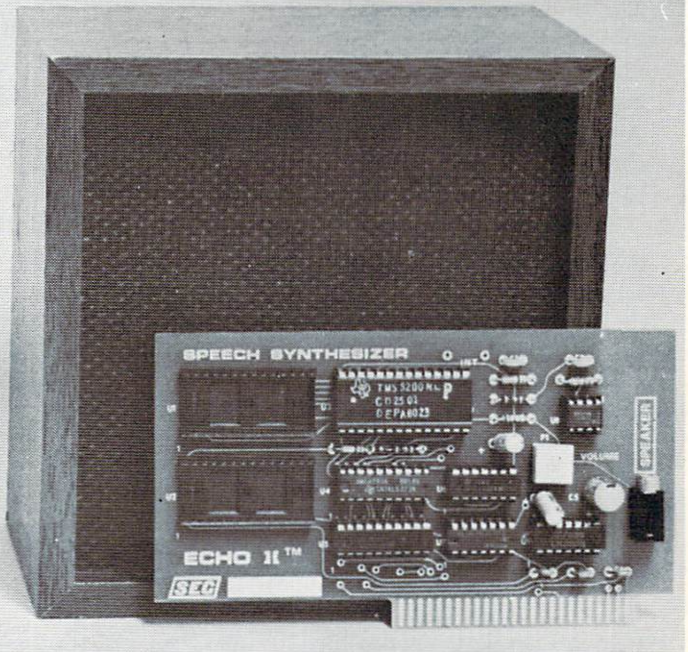

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Clearing The Apple II Low-Resolution Graphics Screen

Sherm Ostrowsky

Many applications require rapidly clearing the low-resolution graphics screen to black (COLOR = 0) or to some other color. In the latter case the process might be more accurately described as "back-grounding". Either way, this apparently simple operation can be done by several different methods. Each method will produce a distinctly different visual effect while in operation, although the end result will be the same. By doing the experiments to be described below, the experienced programmer can learn how to use the method best suited to his immediate purpose, and the novice programmer can learn some useful facts about the operation of the Apple low-resolution graphics. So go ahead and do the experiments on your Apple; you can't hurt it by pushing the keys (even the wrong keys), and you can learn a lot.

First of all, in order to see the effect of any kind of screen-clearing method it is best to begin with a screen that is loaded with colors and forms. You may do this in any way that pleases you; I have been using the following subroutine in Applesoft:

```
1000 GR
1010 FOR I = 0 TO 39
1020 FOR J = 0 TO 39
1030 COLOR = 1 + INT(15*RND(1))
1040 PLOT J, I
1050 NEXT J, I
1060 FOR PAUSE = 0 TO 2000: NEXT PAUSE
1070 RETURN
```

Notice that this subroutine colors-in the so-called "mixed screen" — the top 40 lines, but not the bottom part reserved for text. If you wish to use, and color-in, the whole screen (48 graphics lines), then the first two lines of the Applesoft subroutine can be amended to:

```
1000 POKE -16302,0 : POKE -16304,0
1010 FOR I = 0 TO 47
```

etc. The line of POKEs turns on the "soft switches" governing the full-screen lo-res graphics (see pages 12-13 in the new Apple II reference manual).

Now that the screen is colored, let's clear it. The first method which is likely to occur to the average programmer is to write a couple of lines in Applesoft. Suppose you want to clear the screen to a particular background color, say C (C = 0 to 15). A program to do this for a mixed screen might look like this:

```
10 GOSUB 1000 : REM PAINT THE SCREEN
20 COLOR = C
30 FOR I = 0 TO 39
40 VLIN 39,0 AT I
50 NEXT I
60 END
```

Try it. The screen clears rather ponderously, like a stage curtain rolling across from left to right. If you want the curtain to move from right to left, just change line 30 to

```
30 FOR I = 39 TO 0 STEP -1
```

If you want it to operate on whole-screen graphics, line 40 should be altered to

```
40 VLIN 47,0 AT I
```

This method works fine, if you don't mind the relatively slow speed of the clearing operation. In fact, for some special effects it might even be preferred. Notice how you can control the direction of motion of the apparently rolling curtain. As an "exercise for the student", consider how you might change lines 30 and 40 so as to cause the curtain to appear to be rising upwards. That can be a rather pretty effect, especially if you don't just leave a blank screen but instead "paint-in" a scene of some kind to coincide with the rising of the curtain (i.e., one horizontal line at a time, from bottom to top); it can look like a real stage curtain rising to reveal a scene already in place.

But what if you are not satisfied with the relatively slow speed with which an Applesoft program can clear the screen? If you don't mind being restricted to just a basic black clear, there are some dandy machine-language subroutines in the Apple's built-in ROM Monitor which are a lot faster. For mixed-screen graphics, try this little program:

```
10 GOSUB 1000 : REM PAINT SCREEN
20 CALL -1994
30 END
```

That's not only a heck of a lot faster, but pretty simple to use, too! If you're doing full-screen graphics, replace line 20 with

```
20 CALL -1998
```

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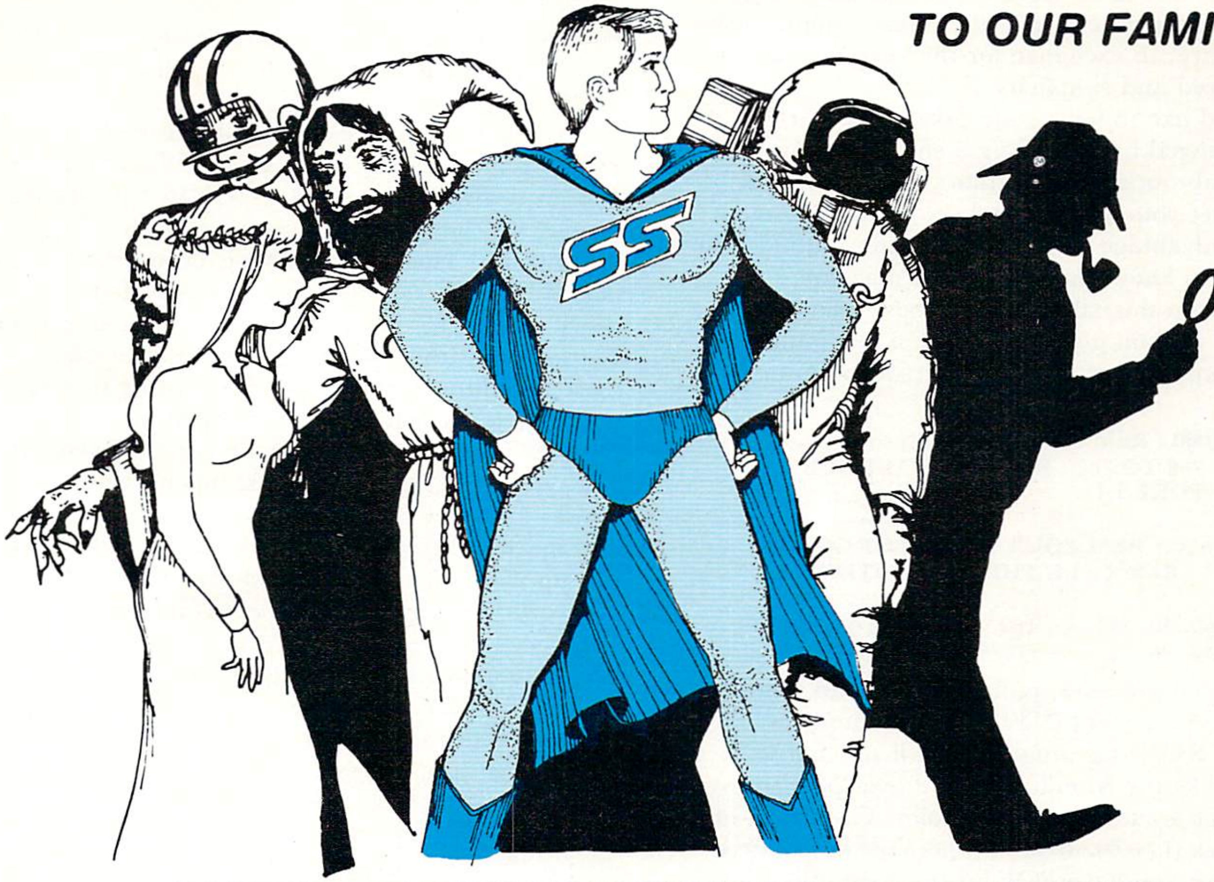

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Very neat. But this way you have no control over the direction of motion of the curtain, nor over the color to which the screen is cleared. Perhaps for your particular application neither of these restrictions makes any difference, in exchange for the very real advantages in speed and simplicity.

If you'd like to have your cake and eat it too, this can be arranged by POKEing a short machine-language subroutine into memory. Then you will be able to select your background color and still retain the speed advantage of the Monitor subroutine. You don't have to know anything about machine-language to do this, although for those who are curious I'll explain how it works in a few minutes. For the moment, just try the Applesoft program below:

```
10 GOSUB 1000 : REM PAINT SCREEN
20 FOR I = 768 TO 782 : REM POKE M/L SUB
30 READ J : POKE I,J
40 NEXT I
50 COLOR = C : REM YOUR CHOICE OF COLOR
60 CALL 768 : REM CALL THE SUBROUTINE
70 END
200 DATA 160, 39, 132, 45, 160, 39, 169, 0, 32, 40, 248,
  136, 16, 248, 96
```

For full-screen graphics, replace the second number in the DATA statment ("39") by the number "47".

If you RUN this program you'll see that it works just like the Monitor version, except that now the screen clears to the selected color, C, instead of only to black (C = 0). It should perhaps be pointed-out that once you have POKEd this subroutine into the computer by executing lines 20 through 40, you can CALL it any number of times in your program without having to POKE it in again. Lines 20 - 40 only have to appear and be executed once in each session at the computer.

Although quite fast, this screen-clearing operation is by no means instantaneous: you can still perceive a curtain-like movement across the screen. What if that's not good enough? I recently wrote a game program in which I wanted the screen to flash suddenly white, to indicate that an enemy torpedo had broken through my screens and wiped me out. Even the machine-language routines are too slow to make a believable explosion flash — an instantaneous white-out. Well, this can in fact be done with the help of a somewhat longer machine-language subroutine which I will now describe. And if you're not into writing game programs, you might still like to be able to clear your screen instantaneously to provide nice sharp transitions from one scene to the next.

The new program looks like this:

```
 70 FOR PAUSE = 0 TO 2000 : NEXT PAUSE
 80 GOSUB 1000 : REM REPAINT SCREEN
 90 FOR I = 800 TO 844 : REM NEW SUB
100 READ J : POKE I,J
110 NEXT I
120 COLOR = C
130 CALL 800 : REM CALL NEW SUBROUTINE
140 END
300 DATA 165, 48, 160, 120, 32, 45, 3, 160, 80, 32, 61,
     3, 96, 136, 153, 0, 4, 153, 128, 4, 153, 0, 5, 153, 128, 5
310 DATA 208, 241, 96, 136, 153, 0, 6, 153, 128, 6, 153, 0,
     7, 153, 128, 7, 208, 241, 96
```

For full-screen graphics, replace the ninth number in DATA statement 300 ("80") by the number "120"

As before, once this new subroutine has been POKEd into memory it can be CALLed whenever you need it without having to rePOKE it (unless, of course, you happen to overwrite it in the meanwhile). This subroutine has been deliberately placed into different memory locations than the previous one, so they can coexist in your computer. Furthermore, the Applesoft routines associated with these two different methods were written in such a way that when both have been typed into your computer as indicated, they will run consecutively. When you type RUN, the screen first fills up with colors, pauses for a few seconds, and then is erased by the first machine-language subroutine. Then the screen fills up with a new random color pattern, pauses, and is suddenly cleared by the second subroutine. The speed difference between these two subroutines is readily apparent in operation.

Each of the several different screen-clearing methods which have been described above has its own special properties; they are all useful additions to your programming arsenal.

Now, for those who are interested, let me briefly discuss the functioning of the two machine-language subroutines. I will assume that the reader is at least somewhat familiar with 6502 Assembly Language and its standard notation.

The first subroutine, starting at location 768 decimal (equivalent to $0300 in hexidecimal) is just a very slightly altered version of the Monitor's routine which we used earlier by CALLing -1994. The Monitor version clears the screen by drawing vertical black lines one after another, exactly as we did it in our very first Applesoft program. The difference in speed between these routines simply reflects the well-known speed advantage of machine-language over Basic. Since the Monitor's version only paints in one color — black — it was changed to permit the color to be an input variable using the standard Applesoft COLOR = C instruction to define which one you want. In Assembler notation, this subroutine looks like this:

```
$0300: A0 27     BKGRND LDY #$27       ; Maximum Y for mixed-screen
                                         clear
 0302: 84 2D            STY V2         ; Store as line-bottom coordinate
 0304: A0 27            LDY #$27       ; Rightmost X-coord (column)
 0306: A9 00     CLRSCR LDA #$00       ; Will start clearing at top
 0308: 20 28 F8         JSR VLINE      ; Jump to line-drawing subroutine
 030B: 88               DEY            ; Next leftmost X-coord (column)
 030C: 10 F8            BPL CLRSCR     ; Loop until done
 030E: 60               RTS            ; Done. Return
```

For full-screen graphics, the number "27" in location $0301 is replaced by the (hexidecimal) number "2F".

The alert reader may have noticed that the color to be used did not appear anywhere in this

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subroutine. In fact, the Applesoft statement COLOR = C automatically stores the appropriate color constant in location $30 (decimal 48), where the Monitor routine VLINE can get at it. VLINE draws a single vertical line of the specified color.

Now, the flash-clear subroutine beginning at location 800 decimal ($0320 hexidecimal) works by taking advantage of the "memory-mapped" nature of the Apple's low-resolution screen. Each of the 1600 screen positions on the mixed screen or the 1920 screen positions on the whole screen is defined by a specific half-byte (four bits, or one "nybble") in memory. Since these four bits can represent one of sixteen different hex numbers ($0 through F), each screen position will have one of sixteen different colors depending on how the defining nybble has been set. The two nybbles in each byte define the color for two screen positions in the same column but consecutive rows, that is, two vertically-stacked colored squares. To color a given square it is only necessary to find its corresponding nybble and set it to the appropriate value.

Unfortunately, for some reason the Apple designers didn't arrange the memory locations in any simple consecutive fashion to correspond to the screen rows in numerical order. It requires a special algorithm to find the byte which represents the first square of each row; all the rest of the squares in that row will be represented by consecutive bytes after that. To further complicate matters, the last eight bytes in every 128 bytes do not correspond to any screen positions at all, but rather are used as "scratchpad" memory for whatever devices might be in the motherboard slots.

This last little detail makes the required subroutine for clearing the screen much more complicated than it would otherwise have to be. It is necessary to take the byte in location $30, which represents the chosen color nybble repeated twice, and store it in each byte of screen memory, being careful not to disturb those special bytes which are possibly being used as scratchpad. The address of the first and last effective byte of each row in screen memory has to be known in advance in order to perform this operation in the fastest possible time, without taking time to compute these addresses during the operation. All this has been done in the algorithm represented by the assembly-language subroutine below:

```
$0320: A5 30    FLASH   LDA COLOR  ; Get selected color byte
 0322: A0 78            LDY #$78   ; Prepare to fill 120 bytes
 0324: 20 2D 03         JSR FILL1  ; Fill four sets of 120 bytes each
 0327: A0 50            LDY #$50   ; Prepare to fill 80 bytes
 0329: 20 3D 03         JSR FILL2  ; Fill four sets of 80 bytes each
 032C: 60               RTS        ; Done. Return.
      ; Subroutine FILL1 puts the selected color byte into
      ; each of four sets of 120 consecutive screen-memory
      ; bytes, being careful to avoid the scratchpad bytes at
      ; the end of each set.

 032D: 88       FILL1   DEY
 032E: 99 00 04         STA $400, Y
 0331: 99 80 05         STA $480, Y
 0337: 99 80 05         STA $500, Y
 033A: D0 F1            STA $580, Y
 033C: 60               BNE FILL1
                        RTS
      ; Subroutine FILL2 puts the selected color byte into each
      ; of four sets of 80 consecutive screen-memory bytes.
      ; These are the "short lines", leaving out at the end of
      ; each one of the four text lines at the bottom of the
      ; mixed screen.

 033D: 88       FILL2   DEY
 033E: 99 00 06         STA $600, Y
 0341: 99 80 06         STA $680, Y
 0344: 99 00 07         STA $700, Y
 0347: 99 80 07         STA $780, Y
 034A: D0 F1            BNE FILL2
 034C: 60               RTS
```

For full-screen graphics, the "short lines" of the subroutine FILL2 become full-length lines as in FILL1, which is accomplished simply by changing the constant "$50" in location $0328 to a "$78".

And that's how we clear the screen in a flash. But before I quit, I'd like to leave you with one more little idea. If, instead of setting the color byte by an Applesoft line of the form COLOR = C, you simply POKE into location 48 (decimal) any integer less than 256 (decimal), you may get a surprise. Depending on what integer you POKE, the screen may "clear" to a pattern of horizontal stripes! I'll bet that some clever reader out there will find some interesting and unexpected application for it. ©

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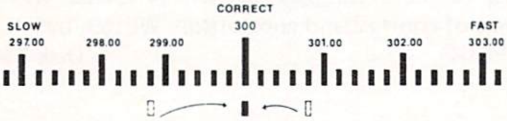

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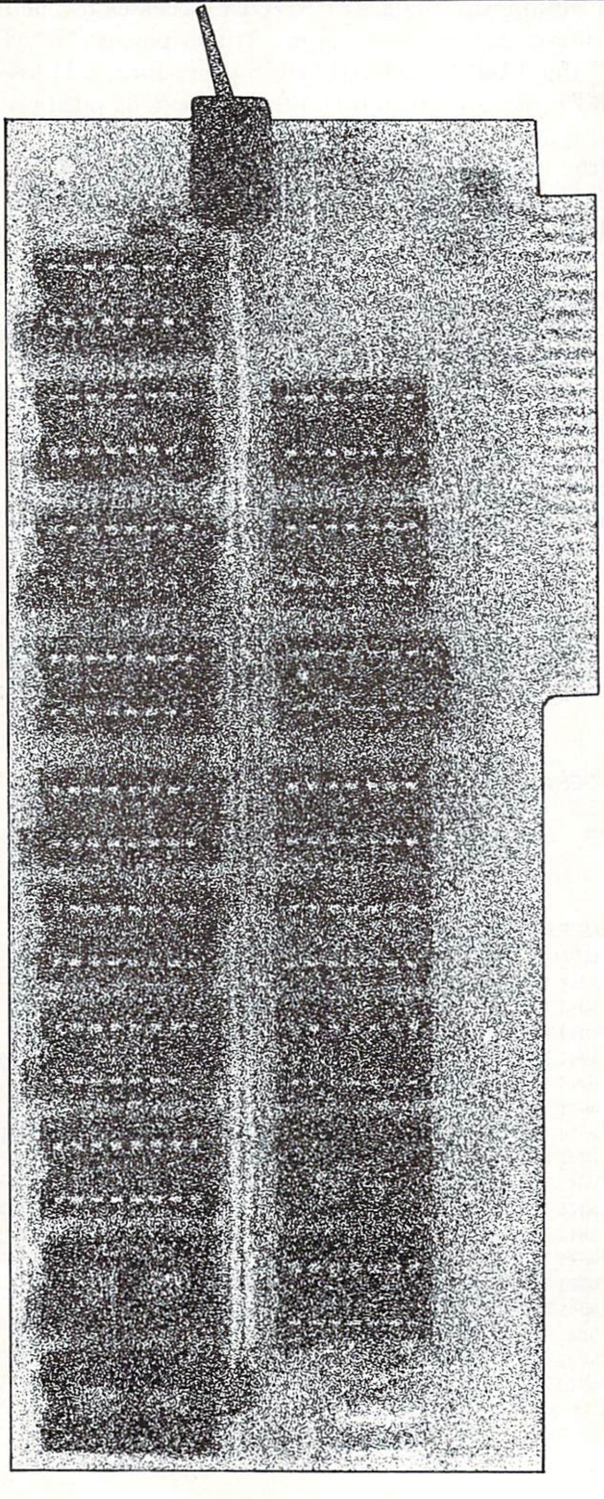

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Fun With Apple and Pascal

Gene A. Mauney
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While using Kenneth Bowles' excellent textbook, **Problem Solving Using PASCAL,** to self teach Pascal, it occurred to me to write this game program and make learning Pascal even more exciting. Since completing this writing I have discovered that Bowles' 1980 book, **Beginner's Guide for the USDA Pascal System,** would have helped and I am sure will be helpful with my next Pascal ventures.

I tried to use as many of the Apple-Pascal graphics functions as feasible in order to gain experience with these and of course depended on the **Apple Pascal Reference Manual** for this. From TURTLEGRAPHICS used are: MOVE, MOVETO, TURN, TURNTO, GRAFMODE, TEXTMODE, VIEWPORT, FILLSCREEN, TURTLEX, TURTLEY, WCHAR, and CHARTYPE. And from APPLESTUFF the RANDOM, PADDLE, BUTTON, and NOTE functions.

My plan was to use as much as would fit in with my study of the beginning lessons in Bowles' textbook along with developing a program for a game suggested to me by Peter Hildebrandt, to whom goes my appreciation. Also thanks to Bill Stanley for his helpfulness. In these beginnings I found that it would have been very helpful to have had some real Apple-Pascal programs for examples. So my hope is that this real program will be helpful for those readers who are beginners as I. No claims are made as to the most efficient methods for programming and I am sure that others will be able to find improvements. I will be happy to hear from anyone who has comments and suggestions. I hope programmers and players will enjoy it.

The Program

BEGIN(*MAIN*) first draws the Pentagon War Games frame using the TURTLE, then proceeds to the MOVEPENT PROCEDURE. The program switches back and forth between MOVEPENT and IFPADDLE. MOVEPENT creates the pentagons beginning at a random start point (AX,AY) with SIDE = 1, and moving from there in random ways increasing by SIDE + 3 (*NOTE6*) each time for nine times. Here is a place to change the difficulty level for the player if you wish. NINE counts the times through to know when nine pentagons have been formed and also to know the score for adding up totals. IFPADDLE accesses the paddle position and moves the gun. At two places (*NOTE 4*) the TURTLEGRAPHICS procedure, CHARTYPE(6), is used to turn off the previous position of the gun and bullets by XORing the image. CHR(11) is the up arrow used for gun and bullet. If BUTTON(0) is pushed so is TRUE, the IFBUTTON PROCEDURE produces the four bullets with sound each. Hit or miss is determined (*NOTE 5*) by using the last value of X, the lower left corner of the pentagon and the last value of SIDE along with the paddle position. If a hit is made, NINE, SCORE and TSCORE are added up, destruction of the pentagon is shown along with sound (*NOTE 3*), and the message shown. The TURTLEX and Y functions are used (*NOTE 2*) to determine the X,Y value of the pentagon corner for the destruction picture and 20 lines are used here. The procedure FILLSCREEN is used (*NOTE 1*) to erase the last pentagon just before the destruction image. Finally, after five pentagon attacks, the end message is shown along with the total score.

```
PROGRAM PENTAWAR;
USES TURTLEGRAPHICS, APPLESTUFF;
VAR    SCORE,TSCORE,X,Y,
       NINE,SIDE,PENTA: INTEGER;


PROCEDURE THEEND;
BEGIN
  TEXTMODE;WRITELN;WRITELN;
  WRITELN('* * *    PENTAGON WARS    * * *  ');
  WRITELN;WRITELN;
  WRITELN('      YOUR TOTAL SCORE IS ',TSCORE);
  WRITELN;WRITELN;WRITELN;
  WRITELN('DIRECTIONS: ');
  WRITELN('YOU WILL SEE 5 PENTAGON ATTACKS.');
  WRITELN('YOU WILL GET ONLY 5 SHOTS.');
  WRITELN('MAXSCORE IS 45 IF YOU HIT THE');
  WRITELN('SMALLEST PENTAGON OF EACH ATTACK.');
  WRITELN('(9,8,7,..0 AS PENTAGONS ATTACK.)');
  WRITELN('USE APPLE GAME PADDLE 0.   ');
  WRITELN;WRITELN;WRITELN;
  WRITELN('     PRESS RETURN THEN R FOR');
  WRITELN;
  WRITELN('     A NEW GAME.  GOOD LUCK!');
  WRITELN;
END;


PROCEDURE MISS;
VAR  TIME:  INTEGER;
BEGIN
  TEXTMODE;WRITELN;WRITELN;
  WRITELN; WRITELN;WRITELN;
  WRITELN('          YOU MISSED !');
  WRITELN;
  WRITELN('  ONLY ONE SHOT PER ATTACK.');
  WRITELN('    BETTER LUCK NEXT TIME.');
  WRITELN;
  WRITELN('  PRESS BUTTON TO CONTINUE.');
  WRITELN; WRITELN;WRITELN;
  WRITELN; WRITELN;WRITELN;
  FOR TIME:= 1 TO 800 DO
  BEGIN END;        (*WAIT BUTTON RELEASE*)
```

```
    REPEAT NINE:= 0
    UNTIL BUTTON(0);
  FOR TIME:= 1 TO 200 DO
  BEGIN END;               (*WAIT AGAIN*)
END;

PROCEDURE HIT;
VAR  HITS,LENGTH,ANGLE,
     TX,TY,PITCH,DUR,TIME:   INTEGER;
BEGIN
  SCORE:= NINE + 1;
  TSCORE:= TSCORE + SCORE;
  VIEWPORT(2,277,90,180);
  FILLSCREEN(BLACK);             (*NOTE 1*)
  VIEWPORT(0,279,0,191);
  MOVETO(X,Y); TURNTO(90);
  LENGTH:=21; ANGLE:=120;
  DUR:=1; PITCH:=40;
  FOR HITS:= 1 TO 20 DO         (*NOTE 2*)
    BEGIN
      PENCOLOR(WHITE);
      MOVE(LENGTH);
      TX:=TURTLEX;   TY:=TURTLEY;
      PENCOLOR(BLACK);
      TURN(180); MOVE(LENGTH);
      MOVETO(TX,TY);
      TURN(ANGLE);
      LENGTH:=LENGTH-1; ANGLE:=ANGLE-2;
      NOTE(PITCH,DUR); PITCH:=PITCH-2;
    END;                         (*NOTE 3*)
    TEXTMODE;
    WRITELN;WRITELN;WRITELN;WRITELN;
    WRITELN('          A HIT ! ! !');
    WRITELN;WRITELN;
    WRITELN('          SCORE IS ',SCORE);
    WRITELN;WRITELN;
    WRITELN('   PRESS BUTTON TO CONTINUE.');
    WRITELN;WRITELN;
    WRITELN;WRITELN;WRITELN;WRITELN;
    FOR TIME:= 1 TO 800 DO
    BEGIN END;       (*WAIT BUTTON RELEASE*)
      REPEAT NINE:= 0
      UNTIL BUTTON(0);
    FOR TIME:= 1 TO 200 DO
    BEGIN END;                 (*WAIT AGAIN*)
END;

PROCEDURE IFBUTTON;
VAR  PX,BUL,TWO,PITCH,DUR:   INTEGER;
BEGIN
  PX:= (PADDLE(0)+19);
  MOVETO(PX,20);
  FOR PITCH:= 40 TO 50 DO
  BEGIN
    DUR:=1; NOTE(PITCH,DUR);
  END;
  FOR BUL:= 1 TO 4 DO        (*4 BULLETS*)
    BEGIN
      TURNTO(90);              (*TURN UP*)
      MOVE(20);
      FOR TWO:= 1 TO 2 DO
        BEGIN
          CHARTYPE(6);         (*NOTE 4*)
          WCHAR(CHR(11));
          TURNTO(180);
          MOVE(7);
        END;
    END;
    IF (PX > X) AND (PX < (X+SIDE))
      THEN BEGIN HIT;
      END                      (*NOTE 5*)
      ELSE BEGIN MISS;
      END;
END;
```


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```
PROCEDURE IFPADDLE;
VAR  TIME:  INTEGER;
BEGIN
  PENCOLOR(BLACK);
  MOVETO((PADDLE(0)+19),20);
  FOR TIME:= 1 TO 8 DO        (*TIME*)
  BEGIN                       (*ADJUST*)
    CHARTYPE(6);
    WCHAR(CHR(11));           (*NOTE 4*)
    TURNTO(180);
    MOVE(7);
  END;
  IF BUTTON(0) THEN
  BEGIN
    IFBUTTON;
  END;
END;



PROCEDURE MOVEPENT;
VAR  DRAW,EACHONE,
        AX,BX,CX,NX,AY,BY:  INTEGER;
BEGIN
  REPEAT
  PENTA:= PENTA+1; SCORE:= 0;
  NINE:= 9; SIDE:= 1; BY:= 1; NX:= 1;
  AX:= 40+RANDOM MOD(200);
  AY:= 166;
  PENCOLOR(BLACK);
  MOVETO(AX,AY);         (* PENTAGON START*)
  WHILE NINE > 0 DO      (*9 PENTAGONS EACH*)
  BEGIN
    VIEWPORT(1,278,90,180);
    FILLSCREEN(BLACK);         (*CLEAR SCREEN*)
    VIEWPORT(0,279,0,180);
    GRAFMODE;
    BX:= RANDOM MOD(6+NX);
    CX:= RANDOM MOD(6+NX);
    BX:=BX-CX; BY:=BY+8; NX:=NX+4;
    X:=AX-BX; Y:=AY-BY;
    SIDE:= SIDE+3;              (*NOTE 6*)
    NINE:= NINE-1;
    PENCOLOR(BLACK);
    MOVETO(X,Y); TURNTO(0);
    PENCOLOR(WHITE);
    FOR EACHONE:= 1 TO 5 DO
    BEGIN                       (*5 SIDES*)
      MOVE(SIDE);
      TURN(72);          (*PENTAGON ANGLE*)
    END;
    IFPADDLE;
  END;
  UNTIL PENTA = 5;       (*AT END OF GAME*)
  THEEND;
END;



BEGIN                  (*MAIN*)
  INITTURTLE;
  MOVETO(0,0);
  PENCOLOR(WHITE);     (*DRAW THE FRAME*)
  MOVETO(279,0);
  MOVETO(279,191);
  MOVETO(0,191);
  MOVETO(0,0);
  PENCOLOR(BLACK);
  RANDOMIZE;
  PENTA:= 0; TSCORE:= 0;
  MOVEPENT;
  READLN;              (*WAIT FOR <RTN>*)
END.
```

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Flipping Your Disk

M. G. Sieg

If you own an APPLE DISK II, you can double the storage capacity of a single mini-floppy at virtually no cost. The only things you need are at least two floppies, a hand held hole punch, and a colored pencil that will show on black.

The trick is simple, make your single sided floppy into a dual sided "flipped" floppy.

First, let's get acquainted with the anatomy of a floppy disk. Externally there is a black jacket with several holes cut into it. The inside of the jacket is lined with a white fabric which can only be seen by prying the jacket apart a bit at the center hole. Through the holes, the rust colored disk can be seen. The rust color is a coating on a mylar surface enabling the drive to read and record information much the same as the tape for your cassette recorder.

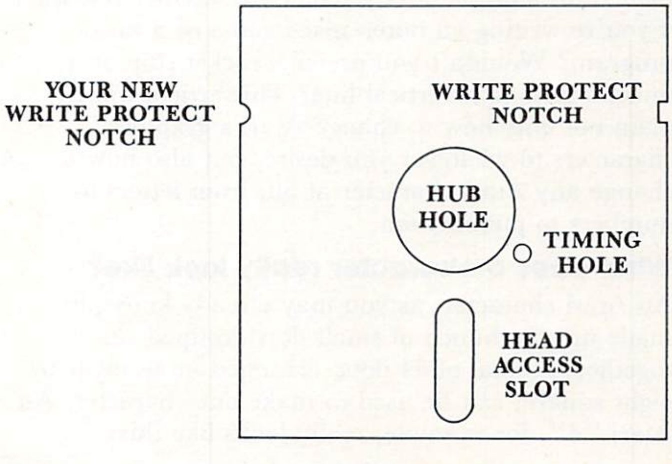
The hole in the center of the jacket is the hub hole. This permits the disk drive motor to engage the disk and spin it. The long wide slot just below the hub hole is called the head access slot. It permits the read/write head and the pressure pad to access the spinning disk. IMPORTANT: Avoid touching the disk surface through this slot. Fingerprints on the recording surface in this area can cause I/O errors. Just to the right of the hub hole is a small hole through which the disk surface can be seen at times or, at other times, a hole completely through the other side of the jacket appears. This is the timing hole. Finally, in the upper right corner (if you consider the head access slot the bottom) of the jacket, there is a rectangular slot. This is the write protect notch. When the floppy is inserted into the drive, a mechanical switch can slip into this notch signalling the drive that it is OK to write on this disk. If the notch is not present or is covered with a piece of tape the disk is "write protected" thereby preventing the APPLE from writing anything on this disk — even the initialization information.

By duplicating this write protect notch at the same position on the left side of the jacket, the disk can be turned over and the DISK II may write on the "flip" side. The APPLE DISK is different than most other drives because it ignores the timing hole, using the motor and 'soft' timing techniques instead.

If you follow these instructions carefully, a good 90% of major brand mini-floppies can be turned into "flipped" floppies. Place two disks in front of you face up on a very clean surface. Once again you are cautioned not to touch the recording surface through the head access slot. Take one of the disks and place it flipped over on top of the other, such that the head access slots are at the bottom. Align them both exactly and, with a light colored pencil, make a mark on the bottom disk along the inside edge of the flipped floppy's write protect notch. With a standard hole puncher, punch a half hole (i.e. no further into the jacket than your pencil mark) completely through both sides of the jacket at your pencil mark. This half hole is now the write protect notch for the flip side. The fact that this hole is round is of no consequence, since the only thing of importance is that the mechanical switch inside your drive can drop into a notch of some type.

Test your "flipped" floppy by inserting it into the drive (flipped side up naturally) and doing the normal INIT procedure. If you get several groans from your drive followed by an I/O ERROR, you may not have your notch deep enough or you may have run into one of the 10% or so disks that have flaws in the flipped surface. If you suspect your notch may not be deep enough, very carefully cut away a little more of the jacket. You must be careful not to cut into the disk surface, for that may ruin the disk completely. Assuming you have reasonable quality disks, the flipped surface having a flaw will be a rare problem but has no solution. If you should be unlucky enough to have this occur first time out, don't be discouraged; try another disk.

These flipped floppies may now be used exactly as you use all the normal disks in your collection.



This is what your flipped floppy should look like *after* following the procedures.

Editor's Note: While we've printed this article as a reader service, you should be **well aware** *of the risks involved. Disks made for single sided use may contain flaws on the reverse side. We can't vouch for the author's 10% figure. In essence, try this at your risk! RCL*

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THE ATARI® GAZETTE

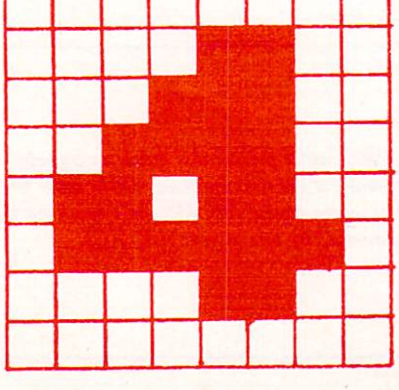
Designing Your Own Atari Character Sets

Craig Patchett
Greenwich, CT

If you want to draw boxes, or design a card game, then Atari's graphics characters are terrific. But what if you're writing an outer-space game or a music program? Wouldn't you prefer a rocket ship or a musical note to a vertical line? This article will explain not only how to change Atari's graphics characters to whatever you desire, but also how to change any Atari character at all, from letters to numbers to punctuation.

What does a character really look like?

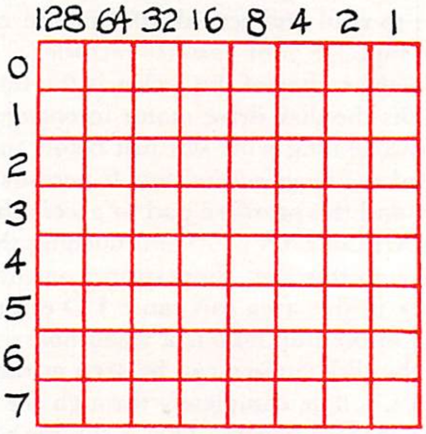
An Atari character, as you may already know, is made up of a bunch of small dots grouped close together. A total of 64 dots, arranged in an eight-by-eight square, can be used to make one character. An Atari "4", for example, really looks like this:



Here, the squares colored in represent the dots that are used. Notice that the outside squares are not used. If they were, then the characters would touch each other when printed side by side, and would be difficult to read. Graphics characters can be made to touch, however, since side by side they could be made to look like one large, continuous character.

How does the Atari know which dots to use for each character?

Somewhere in memory the Atari has a list of which dots are used for each character. Before we find out where this list is, let's see how the Atari represents each character in the list.



The Atari remembers each character as eight numbers, each representing a row of eight dots. These rows I have numbered above from 0 to 7. Row 0 is always the first number, row 7 the last. The Atari changes each row of dots into a number from 0 to 255 in the following way. Each dot in the row is assigned a multiple of two (fron 1 to 128) as its value, as shown above. To get the number for a given row, just add up the values of the dots used in that row. For example, let's look at the "4". The first number will be 12, since dots 4 and 8 are being used in row 1 (4 + 8 = 12). The third number will be 28, since dots 4, 8, and 16 are being used in row 2 (4 + 8 + 16 = 28), and so on down to row 7, which will be 0, since no dots are being used. Before going on, make sure you understand how to get the following eight numbers as representing the number "4": 0, 12, 28, 60, 108, 126, 12, 0.

Where does the Atari store the list?

Since there are a total of 128 Atari characters, not counting reverse characters (see Appendix C: ATASCII Character Set, in the BASIC Reference

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Manual), the list will contain 1024 numbers (8 numbers per character X 128 characters = 1024 numbers), Look at Appendix D: Atari 400/800 Memory Map in the BASIC Reference Manual. This simply describes what some of the different memory locations are used for. We're interested in the first locations, containing the "Operating System ROM." The Operating System is just a program that tells the Atari how to do everything it can do in the "Memo Pad" mode, simple things such as putting a character on the screen when a key is pressed, etc. ROM means that the program will always be in the computer's memory, even when the computer is turned off, and can never be changed by the programmer (that's you). Unfortunately, the first 1024 locations in the Operating System ROM (locations 57344 to 58367) contain the list of numbers we are interested in. In order to change the characters we are going to have to change the list, which ROM won't let us do. There's an easy way out, however, and that's to move the list to a place where we can change it.

Where do we move the list to?

We need a place where the list will be safe from us accidentally changing it, but where we will be able to change it when we want to. Looking at Appendix D again, about halfway down the page is a box labeled "RAMTOP". RAMTOP points to the last location in user memory, the memory we have available for our use. What if we were to change RAMTOP so that it pointed 1024 locations before the end of user memory? Then the Atari would think that user memory ended at the new RAMTOP and would not try to put anything in memory after that location. We would still be able to use those locations ourselves though. Let's flip over to Appendix I: Memory Locations. If we look up decimal location 106, we see that it contains the value of RAMTOP. So if we change location 106, we can trick the Atari into staying away from our list. Before we do that, however, let me point out that adding one to the value in 106 actually adds 256 to RAMTOP. This is because of something called "paging", which is too complicated to explain here, and not really important for what we're doing anyway. Just be aware that to move RAMTOP back 1024 locations, we need to subtract four (4x256 = 1024) from location 106. To give us some extra space in case the Atari accidentally goes a little past RAMTOP, we'll subtract five instead. We do this using POKE and PEEK as such (finally some programming!):

```
10 POKE 106, PEEK (106)-5:GRAPHICS 0
```

The reason we use a GRAPHICS Ø right after changing RAMTOP is because the Atari normally stores screen data in the locations we'll be using for the list (see **Designing Your Own Atari Graphics Modes** in the Sept/Oct issue of COMPUTE). If we don't use a GRAPHICS command to move that list to a new location, the screen will do strange things when we move the character list into place, which we are now ready to do (yay!).

How do we move the list?

Moving the list is extremely simple; we just use a FOR/NEXT loop and POKE the values from ROM into their new locations. We first need to figure out the value of the location of the first number in the new list as such:

```
20 STARTLIST = (PEEK(106) + 1)*256
```

Remember, we subtracted an extra one from location 106 to be safe, so we have to add it back on to determine the start of the list. Also don't forget that we have to multiply the value in 106 by 256 because of paging. Now let's move (!):

```
30 ? "HOLD ON...":FOR MOVEME = 0 TO 1023:POKE
STARTLIST + MOVEME,PEEK(57344 + MOVEME):
NEXT MOVEME
```

All that's left now is to tell the Atari where the new list is. We do this by changing the value in location 756, which points to the starting location of the character set to be used (look at Appendix I). If you look at location 756 at this stage (use PRINT PEEK(756)), you'll see that it contains the value 224. Again, because of paging, this really means 224 x 256, or 57344 (surprise!), the starting location of the character set in ROM. So we go:

```
40 POKE 756,STARTLIST/256
```

A few words of warning about location 756. Everytime you use the GRAPHICS command, the Atari sets the value in location 756 back to 224. That means that after each GRAPHICS command, you'll have to execute the equivalent of line 4Ø. No big deal, but if you forget...

Let's change some characters!

Before we actually make any changes, let's look at the order the characters are stored in the list. For this we'll need Appendix C again (and you thought you'd never use the Appendices!). Unfortunately, Atari chose not to store the characters in memory exactly in the ATASCII order. Almost, but not exactly:

TYPE	ATASCII ORDER	MEMORY ORDER
uppercase, numbers, punctuation	32-95	0-63
graphics characters	0-31	64-95
lowercase, some graphics	96-127	96-127

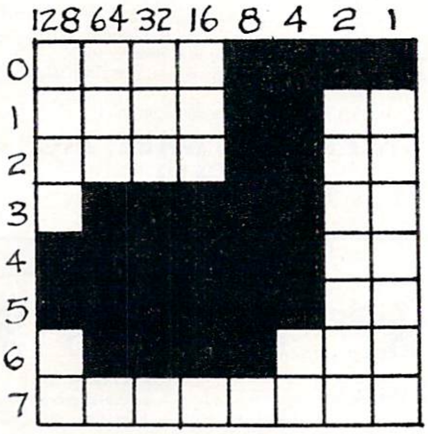
As you can see, all that Atari did was to move the graphics characters between the uppercase and lowercase (they did this in order to be able to choose between uppercase and lowercase/graphics in modes one and two). In the meantime, they made our job

harder for us. In order to determine where a character is stored in memory, we have to perform a *little* mathematical wizardry on its ATASCII value. In the following "formulas," keep in mind that each character is represented by eight numbers, which is why we multiply by eight:

ATASCII VALUE (AV)	MEMORY LOCATION (of first number)
32-95	(AV-32)*8 + STARTLIST
0-31	(AV + 64)*8 + STARTLIST
96-127	AV*8 + STARTLIST

Of course, to get the location of the original character (in ROM), we would add 57344 instead of STARTLIST.

With these mathematical manipulations in mind, let's try one of the original examples that I mentioned. We'll change one of the graphics characters, let's say ◄CTRL►T, to a musical note. First, let's design our note:



This may not look exactly like a note as is, but because of the size of the dots, it will look fine when printed on the screen, as we shall soon see. I'll leave it up to you to check for yourself that the note translates into the following eight numbers: 15, 12, 12, 124, 252, 252, 120, 0. We now want to replace the eight numbers already in memory for ◄CTRL►T with these eight. ◄CTRL►T has an ATASCII value of 20 (see Appendix C), which fits in the 0-31 category in the formula chart above. The first thing to do, therefore, is to add 64 (20 + 64 = 84) and multiply by eight (8x84 = 672) to give us a value of 672. So to change the ◄CTRL►T character we would have to change the eight numbers in memory beginning with location 672 + – STARTLIST. We make this change using a FOR/NEXT loop and DATA statements as such:

```
50 FOR MOVEME = 0 TO 7:READ VALUE:POKE 672
 + STARTLIST + MOVEME,VALUE:NEXT MOVEME
60 DATA 15, 12, 12, 124, 252, 252, 120, 0
```

Now, after this has been RUN, whenever we use a ◄CTRL►T, we will have a musical note. Try it!

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As an informal kind of self-test, make sure you understand the following two lines. Try and work out which character they will change, and what the new character will look like, before you actually RUN them (with the rest of the program of course):

```
70 FOR MOVEME = 0 TO 7:READ VALUE:POKE 776
 + STARTLIST + MOVEME,VALUE:NEXT MOVEME
80 DATA 0, 0, 60, 102, 102, 102, 63, 0
```

As you can see, lines 50 and 70 are very much alike except for the initial value added to STARTLIST. This should light up a sign in your brain saying "SUBROUTINE!" If you have more than one or two characters to be redesigned, you should use a subroutine to save memory.

A few details and programming hints.

- In graphics modes one and two, to use lower case and graphics characters with your new character set, POKE 756 with STARLIST /256 + 2. To go back to uppercase, etc., POKE 756 with STARTLIST/256.
- If you press the RESET button, the Atari will change the value of location 106 and put the display list back in place of your character set. Under such circumstances it is necessary to run the program over again in order to get your character set back again.
- If a character is too complicated to put in an eight by eight box, then use more than one box (and therefore more than one character), and combine them in a string. For example, using the Atari's regular graphics characters:

  DIM BOX$(7):BOX$ = " (see below) ":PRINT BOX$
  Type BOX$ as ◄CTRL►Q, ◄CTRL►E, ◄ESC► ◄CTRL► =, ◄ESC►◄CTRL► +, ◄CTRL►Z, ◄CTRL►C.

Bonus: Four Colors In Graphics Mode O!

It is possible to define a character to be one of three different colors (4 = 3 + background). The only drawback is that once you have defined the letter "A" to be orange, for example, all "A"'s will be orange, not just the ones you would like to be.

How do we define the color of a character? It's really quite simple. Just as in graphics mode eight, a dot in an even numbered column will be a different color than a dot in an odd numbered column. Two dots side-by-side will produce yet another color. This is why an Atari "4" (and all other Atari characters) and my musical note have vertical lines that are two dots wide, compared to the horizontal lines that are only one dot wide (or thick if you prefer). If the vertical lines were only one dot wide, they would be a different color than the horizontal ones, unless the horizontal lines alternated one dot on and one dot off. Confused? Don't worry, just substitute the following variations of the musical note for the data in the sample program and see what they look like:

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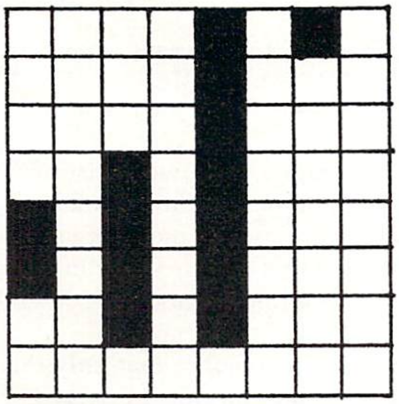
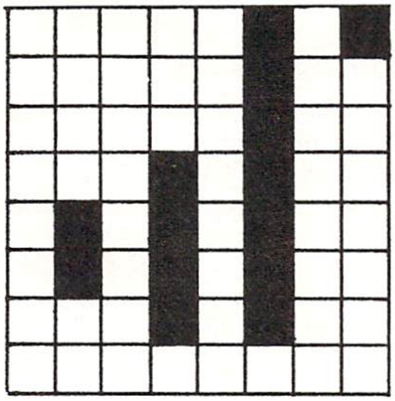
```
60 DATA 10,8,8,40,168,168,32,0
```



```
80 DATA 5,4,4,20,84,84,16,0
```



Such characters will, of course, look unusual in graphics modes one and two, just as they look unusual in the above diagrams.

You can't do a lot of experimenting with this "phenomena" to get such effects as multicolored characters. Changing the background color will change the colors of the columns, and thus the colors of the characters. Finally, if you only need one "A", or whatever, to be a different color, define it as a graphics character.

Bonus: Upper and Lowercase in Graphics Modes 1 and 2.

By now, after hopefully running things over in your mind, you might even suspect already how to mix upper and lowercase in modes one and two. If not, it is a painfully simple trick. Since modes one and two allow use of lowercase and graphics characters together, just redefine the graphics characters to be uppercase letters! You can do this by moving the uppercase character descriptions from the ROM list to your own list like so:

```
35 FOR MOVEME = 256 TO 472:POKE STARTLIST +
MOVEME + 256,PEEK(57344 + MOVEME):NEXT
MOVEME
```

Typing a ◄CTRL►A will now give us an uppercase "A" and so on. Of course, this is not the best way to do it, since we no longer have any graphics characters. If we know that we will only need certain uppercase letters in our program, then it would be better to move just those letters, one by one, using the tables given earlier in the article. In any case, we are now able to mix almost any combination of characters we wish in graphics modes one and two.

And as the sun sets slowly in the west...

I realize that I have attempted to cover quite a bit of information over the course of this article, and most likely was not able to explain everything to everyone's satisfaction. If you have any *pressing* questions with regard to what I have covered here, please feel free to send them to me at the above address, along with any constructive criticism you might also have, and I'll do my best to answer them. Good luck, and always remember; the Atari is your slave and you its master. ©

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Atari BASIC
A Line Renumbering Utility

D. M. Gropper, Newburgh, Indiana

Most programmers developing a program need to insert lines of code into what they have already written. The current version of Atari BASIC does not have a "RENUM" or "RESequence" command available to the user. The following short program was written to give the capability of renumbering BASIC language programs.

Listing 1.

```
9000 PRINT "RENUM UTILITY ACTIVE"
9010 ADDR = PEEK(136) + PEEK(137) * 256
9020 PRINT "INPUT STARTING NUMBER AND"
9030 PRINT "INCREMENT (FORMAT X,Y)"
9040 INPUT START,INCR
9050 LNUM = PEEK(ADDR) + PEEK(ADDR + 1) * 256
9060 NADDR = ADDR + PEEK(ADDR + 2) *256
9070 IF (LNUM = 32768) OR (LNUM = 9000)
  THEN GOTO 9110
9080 LOWNUM = INT(START / 256) :
  HINUM = INT(START - (LOWNUM *256))
9090 POKE ADDR,HINUM : POKE ADDR +
  1,LOWNUM
9100 START = START + INCR: ADDR = NADR :
  GOTO 9050
9110 PRINT "RENUMBERING ENDED AT
  ";START - INCR
9120 END
```

LINE 9010; The address of any BASIC programs' first line is given by the contents of locations 136 and 137.

LINE 9050: The first two bytes, starting at the address from line 9010, contain the actual line number.

LINE 9060: The third byte contains the length of the line in bytes, so adding this to the address given by locations 136, 137 will give the address of the next line.

LINE 9070: Here we are testing for the end of the program, L = 32768, or the start of the utility, L = 9000

LINE 9080: The new line number is broken into two bytes,

LINE 9090: And 'POKEd' back into the line number bytes.

LINE 9100: Update the line number and address and repeat.

LINE 9110: All done... Let's get out of here and tell the programmer what the last line change was.

Listing 2.

```
9010 D = 256 : S = 100 : I = 10 : X = PEEK(136) +
  PEEK(137) * D
9020 L = PEEK(X) + PEEK(X + 1) * D : N = X +
  PEEK(X + 2) : IF (L = 32768) OR (L = 9010) THEN
  END
9030 HN = INT(S/D) : LN = INT(S - (HN * D)) :
  POKE X,LN : POKE X + 1,HN : S = S + I :
  X = N : GOTO 9020
```

This program occupies 534 bytes. Listing 2 is the same thing only compacted down to 289 bytes for those of us who get tight on memory space. A point to note is that listing 2 assumes starting the line renumbering with a line number of 100 and incrementing by 10.

A not so obvious point is that only the line numbers are changed and **not** the sequence of execution. For example:

Taking

```
100 X = 100: ? X
110 Y = 200: ? Y
120 Z = 300: ? Z
```

If we now use listing 1 to resequence starting with 120 and using an increment of -10 (in other words decrementing) then the end result is:

```
120 X = 100: ? X
110 Y = 200: ? Y
100 Z = 300: ? Z
```

The output on the screen on running the renumbered program would be:

```
100
200
300
```

, because the locations 136 and 137 still point to the first line which is now line *number* 120. The third byte at this address is still the **length** of the line in bytes so the next line to be executed is the *now-numbered* 110, etc.

For those of you who like to experiment — take the above example and renumber starting at number 1 and use an increment of 2 and then "LIST" the result. If you bear in mind the editing capability of the Atari then the reason for the "LISTed" result becomes obvious.

One last point — if you do use this utility then please remember that you will have to manually change any "GOSUB" or "GOTO" line references. ©

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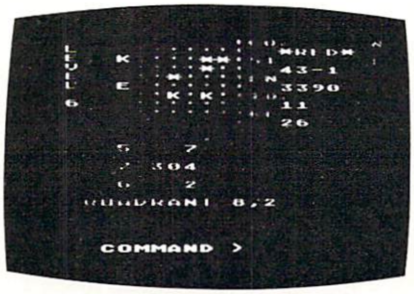

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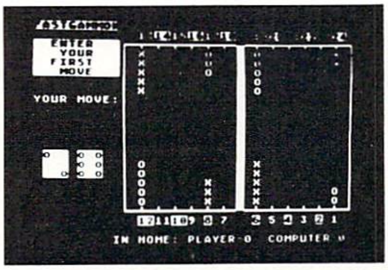

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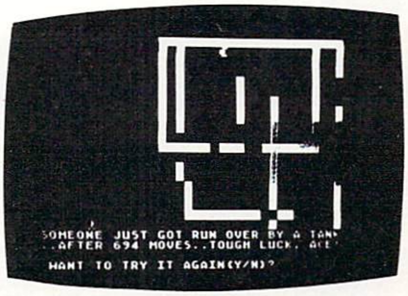

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By Don Ursem

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6502 DISASSEMBLER by Bob Pierce. This neat 8K BASIC program allows you to disassemble machine code, translating it and listing it in assembly language format on the video and on the printer if you have one. 6502 DISASSEMBLER can be used to disassemble the operating system ROM, the BASIC cartridge, and machine language programs located anywhere in RAM except where the DISASSEMBLER itself resides. (Most Atari cartridges are protected and cannot be disassembled using this disassembler.) Also works as an ASCII interpreter, translating machine code into ASCII characters. 6502 DISASSEMBLER requires only 8K of user memory and runs on both the Atari 800 and the Atari 400.

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ATARI Memory Dump and Dissassembler

Robert W. Baker
Atoo, New Jersey

Here's a handy little utility program for the Atari 400/800 systems. It lets you examine any area of memory, either RAM or ROM, in one of two formats. You can select whether you want a straight memory dump or a dissassembly listing. In both formats, the memory locations are given as both decimal and hexadecimal values. The data can be displayed on the television/monitor screen or printed on a printer if available.

When first run, the program takes a minute or two to initialize but from then on it is relatively fast. The starting address for the dump/dissassembly can be entered as either a decimal or hexadecimal number. When entering it as a hexadecimal number, precede the number by a dollar sign ($). You're then asked if a dissassembly is desired. Answering N for no will cause the standard memory dump to be displayed. Answering Y for yes will generate the dissassembly listing.

Before the dump/dissassembly is displayed you are given the option to have the output printed if desired. Answering N for no causes the output to be displayed as normal, using the entire display (24 lines). At the end of each screen you are given the option to continue (C), restart (R), or stop (S). Continue will display the next screen in sequential order. Restarting will return to select the starting address and allow specifying dump/dissassembly and printer options. When printing the data output, the printer will print continuously. Just press any key on the Atari keyboard to halt the printer. When the printer stops you will see the prompt for continue, restart, or stop as mentioned above.

Memory Dump

The memory dump simply displays the contents of eight bytes of memory on each line displayed or printed. The values are given in hexadecimal to conserve display space and to correspond with the dissassembly listings. This feature is very useful for examining pointers or various values stored in memory, that do not happen to be executable machine code instructions. You might want to play around with looking at how BASIC variables or even BASIC lines themselves are stored in memory on the Atari.

For those with 80 column printers (Atari 825, etc.) you can change the FOR-NEXT loop count in line 600 to get 16 bytes per line to conserve paper. Just change line 600 to:

```
FOR X = 1 TO 16:V = PEEK(A)
```

You might even want to change the heading line in line number 302 to print the numbers 0 to 9 plus A to F.

Dissassembly Listing

This feature is much more powerful and can provide a wealth of information. When a dissassembly is requested, the program displays one 6502 machine instruction per line. It indicates the hexadecimal value of one to three bytes of memory that make up the instruction. It also displays the instruction and operand in the standard assembly code forms.

Any unrecognized values are indicated by a "*?*" instead of an instruction mnemonic. You may have to try different starting locations to get the dissassembly to function properly. If you specify an address that happens to be the middle of an instruction, it may dissassemble as a different instruction and/or cause following instructions to be displayed incorrectly. This is always a problem with a dissassembly program of this kind. It is extremely difficult to "sync-up" with the machine instructions whenever there are data bytes between various routines, etc. If you should see a high number of *?*'s displayed, try another starting address, possibly one to two higher or lower than the original address. This should correct the situation.

The dissassembly gives each instruction using standard MOS Technology mnemonics and addressing nomenclatures. Operand values and addresses are shown in hexadecimal and are prefixed by a dollar sign ($) as a reminder. All immediate values are preceded by parenthesis and indexed values are suffixed by a ",X" or ",Y" as appropriate. Zero page addressing is implied by the length of the operand being only a single byte. All branch instructions show the actual computed target address in the dissassembly for added convenience. If required, the relative offset is shown in the object code.

The dissassembly function is extremely useful for examining machine language routines such as those used within the BASIC cartridge itself, or in the operating system ROMs. I'll let you know if I come across anything interesting hidden in the Atari system. Before anyone asks — if you'd like a copy on cassette tape instead of doing all the typing, send $2 to cover costs.

Just a quick note concerning the program listings. The heading lines printed by the BASIC statements in lines 302 and 305 were actually in reverse image to enhance the display. Unfortunately this does not show up in the program listings. I have

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tried to use CHR$(xx) functions in the print statements for clearing the display, etc. to make things easier to read. The Atari printers do not print the graphics and/or control characters that can be included in PRINT statements. Actually they can cause problems if a program is LISTed with these control characters imbedded in PRINT statements. The control characters will be decoded and acted upon by the printer.

```
10 REM ****************************
20 REM
25 REM MEMORY DUMP/DISASSEMBLER
30 REM
35 REM BY: ROBERT W. BAKER
40 REM 15 WINDSOR DR, ATCO NJ 08004
50 REM
60 REM ***** V1.0 ******* 1/4/81 ****
65 REM
70 GRAPHICS 0:POKE 752,1
80 PRINT CHR$(125);"          M E M O R Y
  D U M P   ":? :?
90 PRINT "INITIALIZING ....."
100 DIM H$(16),A$(6),S$(6),M$(1536)
110 H$="0123456789ABCDEF"
120 S$="      "
150 OPEN #1,4,0,"K"
160 FOR X=1 TO 1531 STEP 6
170 READ A$
175 IF A$(2,2)="*" THEN A$(2,4)="*?*"
180 N=LEN(A$):IF N<6 THEN A$(N+1)=S$
185 M$(X,X+5)=A$:NEXT X
200 PRINT CHR$(125);"          M E M O R Y
   D U M P   ":? :?
201 PRINT "ENTER DECIMAL STARTING ADDRES
S":PRINT
202 PRINT "OR HEX ADDRESS PRECEDED BY '$
'":PRINT
203 POKE 752,0
204 INPUT A$:IF A$="" THEN 800
205 IF A$(1,1)="$" THEN 209
206 FOR X=1 TO LEN(A$)
207 IF A$(X,X)<"0" OR A$(X,X)>"9" THEN 2
00
208 NEXT X:A=INT(VAL(A$)/8)*8:GOTO 240
209 A=0:IF LEN(A$)<2 THEN 200
210 FOR X=2 TO LEN(A$)
211 IF A$(X,X)<"0" THEN 200
212 IF A$(X,X)<="9" THEN A=A*16+VAL(A$(X
,X)):GOTO 220
215 IF A$(X,X)<"A" OR A$(X,X)>"F" THEN 2
00
218 A=A*16+ASC(A$(X,X))-55
220 NEXT X
240 PRINT :PRINT "WANT DISSASSEMBLY (Y/N
) ?";
242 GET #1,X:D=0:IF X=78 THEN 245
244 D=1:IF X<>89 THEN 240
245 PRINT CHR$(X)
250 PRINT :PRINT "WANT PRINTED COPY (Y/N
) ?";
252 CLOSE #2
255 P=0:GET #1,X
260 IF X=78 THEN OPEN #2,8,0,"E":GOTO 29
0
270 IF X<>89 THEN 255
280 P=1:OPEN #2,8,0,"P"
290 IF P=0 THEN PRINT CHR$(125);:GOTO 30
0
295 PRINT CHR$(125);"DEPRESS ANY KEY TO
HALT PRINTER":PRINT #2
300 PRINT #2;"LOC-DEC/HEX  ";
302 IF D=0 THEN PRINT #2;"0  1  2  3  4
 5  6  7  ":GOTO 310
305 PRINT #2;" OBJECT   DISSASSEMBLY  "
310 PRINT #2
320 POKE 764,255
330 IF P=0 THEN FOR N=1 TO 20
340 IF A>65535 THEN A=A-65536
350 A$=STR$(A):L=LEN(A$)
360 PRINT #2;S$(1,6-L);A$;" ";
370 Y=A:GOSUB 950
380 PRINT #2;": ";
400 IF D=0 THEN 600
410 V=PEEK(A)
411 GOSUB 1000:PRINT #2;" ";
415 A=A+1:X=(6*V)+1:A$=M$(X,X+5)
420 IF A$(1,1)="0" THEN PRINT #2;"
 ";A$(2,4):GOTO 630
430 V=PEEK(A):GOSUB 1000
432 PRINT #2;" ";:A=A+1
435 IF A$(1,1)="2" THEN 500
440 PRINT #2;"    ";A$(2,4);" ";
445 IF A$(5,5)<>"R" THEN 470
450 IF V>127 THEN V=V-256
460 Y=A+V:GOSUB 900:GOTO 590
470 IF A$(5,5)="#" THEN PRINT #2;"#$";:G
OSUB 1000:GOTO 590
475 IF A$(6,6)=")" THEN PRINT #2;"(";
480 PRINT #2;"$";:GOSUB 1000
482 IF A$(5,5)=" " THEN 590
485 IF A$(5,6)="Y)" THEN PRINT #2;"),Y":
GOTO 630
490 PRINT #2;",";A$(5,6):GOTO 630
500 V1=V:V=PEEK(A):GOSUB 1000:A=A+1
510 PRINT #2;" ";A$(2,4);" ";
515 Y=V1+(256*V)
520 IF A$(5,5)=")" THEN PRINT #2;"(";:GO
SUB 900:PRINT #2;")":GOTO 630
525 GOSUB 900
530 IF A$(5,5)=" " THEN 590
540 PRINT #2;",";A$(5,5):GOTO 630
590 PRINT #2:GOTO 630
600 FOR X=1 TO 8:V=PEEK(A)
610 GOSUB 1000:PRINT #2;" ";
620 A=A+1:NEXT X:PRINT #2
630 IF P=0 THEN NEXT N:GOTO 700
640 IF PEEK(764)=255 THEN 340
```

```
650 GET #1,X
700 POKE 752,1:PRINT
705 PRINT "CONTINUE, RESTART, OR STOP (C
,R,S) ?";
710 GET #1,X:IF X=67 THEN 290
730 IF X=82 THEN 200
740 IF X<>83 THEN 710
800 POKE 752,0:CLOSE #1:CLOSE #2:END
900 PRINT #2;"$";
950 V=INT(Y/256):GOSUB 1000
960 V=Y-(V*256)
1000 H=INT(V/16):L=V-(H*16)
1010 PRINT #2;H$(H+1,H+1);H$(L+1,L+1);
1020 RETURN
9000 DATA 0BRK,1ORAX),0*,0*,0*,1ORA,1ASL
,0*
9010 DATA 0PHP,1ORA#,0ASL,0*,0*,2ORA,2AS
L,0*
9020 DATA 1BPLR,1ORAY),0*,0*,0*,1ORAX,1A
SLX,0*
9030 DATA 0CLC,2ORAY,0*,0*,0*,2ORAX,2ASL
X,0*
9040 DATA 2JSR,1ANDX),0*,0*,1BIT,1AND,1R
OL,0*
9050 DATA 0PLP,1AND#,0ROL,0*,2BIT,2AND,2
ROL,0*
9060 DATA 1BMIR,1ANDY),0*,0*,0*,1ANDX,1R
OLX,0*
9070 DATA 0SEC,2ANDY,0*,0*,0*,2ANDX,2ROL
X,0*
9080 DATA 0RTI,1EORX),0*,0*,0*,1EOR,1LSR
,0*
9090 DATA 0PHA,1EOR#,0LSR,0*,2JMP,2EOR,2
LSR,0*
9100 DATA 1BVCR,1EORY),0*,0*,0*,1EORX,1L
SRX,0*
9110 DATA 0CLI,2EORY,0*,0*,0*,2EORX,2LSR
X,0*
9120 DATA 0RTS,1ADCX),0*,0*,0*,1ADC,1ROR
,0*
9130 DATA 0PLA,1ADC#,0ROR,0*,2JMP),2ADC,
2ROR,0*
9140 DATA 1BVSR,1ADCY),0*,0*,0*,1ADCX,1R
ORX,0*
9150 DATA 0SEI,2ADCY,0*,0*,0*,2ADCX,2ROR
X,0*
9160 DATA 0*,1STAX),0*,0*,1STY,1STA,1STX
,0*
9170 DATA 0DEY,0*,0TXA,0*,2STY,2STA,2STX
,0*
9180 DATA 1BCCR,1STAY),0*,0*,1STYX,1STAX
,1STXY,0*
9190 DATA 0TYA,2STAY,0TXS,0*,0*,2STAX,0*
,0*
9200 DATA 1LDY#,1LDAX),1LDX#,0*,1LDY,1LD
A,1LDX,0*
9210 DATA 0TAY,1LDA#,0TAX,0*,2LDY,2LDA,2
LDX,0*
9220 DATA 1BCSR,1LDAY),0*,0*,1LDYX,1LDAX
,1LDXY,0*
9230 DATA 0CLV,2LDAY,0TSX,0*,2LDYX,2LDAX
,2LDXY,0*
9240 DATA 1CPY#,1CMPX),0*,0*,1CPY,1CMP,1
DEC,0*
9250 DATA 0INY,1CMP#,0DEX,0*,2CPY,2CMP,2
DEC,0*
9260 DATA 1BNER,1CMPY),0*,0*,0*,1CMPX,1D
ECX,0*
9270 DATA 0CLD,2CMPY,0*,0*,0*,2CMPX,2DEC
X,0*
9280 DATA 1CPX#,1SBCX),0*,0*,1CPX,1SBC,1
INC,0*
9290 DATA 0INX,1SBC#,0NOP,0*,2CPX,2SBC,2
INC,0*
9300 DATA 1BEQR,1SBCY),0*,0*,0*,1SBCX,1I
NCX,0*
9310 DATA 0SED,2SBCY,0*,0*,0*,2SBCX,2INC
X,0*
```

```
LOC-DEC/HEX   0  1  2  3  4  5  6  7

 40992 A020:  95 00 E8 94 00 E8 E0 92
 41000 A028:  90 F6 A2 86 A0 01 20 7F
 41008 A030:  A8 A2 8C A0 03 20 7F A8
 41016 A038:  A9 00 A8 91 84 91 8A C8
 41024 A040:  A9 80 91 8A C8 A9 03 91
 41032 A048:  8A A9 0A 85 C9 20 F8 B8
 41040 A050:  20 41 BD 20 72 BD A5 92
 41048 A058:  F0 03 20 99 BD 20 57 BD
 41056 A060:  A5 CA D0 9C A2 FF 9A 20
 41064 A068:  51 DA A9 5D 85 C2 20 92
 41072 A070:  BA 20 F4 A9 D0 EA A9 00
 41080 A078:  85 F2 85 9F 85 94 85 A6
 41088 A080:  85 B3 85 B0 85 B1 A5 84
 41096 A088:  85 AD A5 85 85 AE 20 A1
 41104 A090:  DB 20 9F A1 20 C8 A2 A5

  ***** SAMPLE MEMORY DUMP *****
```

```
LOC-DEC/HEX    OBJECT     DISSASSEMBLY

 40992 A020:  95 00       STA $00,X
 40994 A022:  E8          INX
 40995 A023:  94 00       STY $00,X
 40997 A025:  E8          INX
 40998 A026:  E0 92       CPX #$92
 41000 A028:  90 F6       BCC $A020
 41002 A02A:  A2 86       LDX #$86
 41004 A02C:  A0 01       LDY #$01
 41006 A02E:  20 7F A8    JSR $A87F
 41009 A031:  A2 8C       LDX #$8C
 41011 A033:  A0 03       LDY #$03
 41013 A035:  20 7F A8    JSR $A87F
 41016 A038:  A9 00       LDA #$00
 41018 A03A:  A8          TAY
 41019 A03B:  91 84       STA ($84),Y
 41021 A03D:  91 8A       STA ($8A),Y
 41023 A03F:  C8          INY
 41024 A040:  A9 80       LDA #$80
```

```
41026 A042: 91 8A      STA ($8A),Y
41028 A044: C8         INY
41029 A045: A9 03      LDA #$03
41031 A047: 91 8A      STA ($8A),Y
41033 A049: A9 0A      LDA #$0A
41035 A04B: 85 C9      STA $C9
41037 A04D: 20 F8 B8   JSR $B8F8
41040 A050: 20 41 BD   JSR $BD41
41043 A053: 20 72 BD   JSR $BD72
41046 A056: A5 92      LDA $92
41048 A058: F0 03      BEQ $A05D
41050 A05A: 20 99 BD   JSR $BD99
41053 A05D: 20 57 BD   JSR $BD57
41056 A060: A5 CA      LDA $CA
41058 A062: D0 9C      BNE $A000
41060 A064: A2 FF      LDX #$FF
41062 A066: 9A         TXS
***** SAMPLE DISSASSEMBLY *****
```

©

Formatted Output for ATARI Basic

Joseph J. Wrobel

Many folks tell me that they must struggle to produce nicely formatted output when using ATARI Basic due to the lack of the TAB function and the PRINT USING command. Struggle no more. When used together, the two subroutines presented in this article can provide formatted output simply and directly in ATARI Basic. Both numerics and strings are supported. The type, arrangement and format of variables which appear on one output line are controlled on a line-by-line basis by the main program. The number of variables in one output is limited only by the character width of the output device. The output device can be the TV screen or any type of printer, ATARI or otherwise.

The approach to formatted output used here employs two subroutines. The purpose of the first is to construct a line for output in a string variable set aside for this purpose. Each time the subroutine is called, it inserts the data sent to it by the main program at the selected position in the string and in the format requested. When all the data to be printed in the current line has been positioned, the second subroutine is called. This subroutine merely prints the output line string on the appropriate device, then clears the string (fills it with spaces) to prepare it for the next line of data.

A sample program using the routines is given in Listing 1. Line 10 is required to set aside the strings to be used in the subroutines. LINE$ is the string which will ultimately contain the formatted output line. It is dimensioned to a size one less than the character width of the output device. In the example, for the 38 character wide default screen size, it is dimensioned to hold up to 37 characters by setting NC to 37. Line 20 initializes LINE$ to a string of spaces. N$ is a string used to temporarily store each data item. It should be big enough to hold the largest of your data items. To be on the safe side, its length is set equal to that of LINE$.

The actual subroutines of interest reside in lines 1000-1070 and lines 2000-2010 respectively. The latter routine, as noted above, simply prints LINE$ (line 2000) then fills it with spaces (line 2010) in preparation for the next output line. If, instead of the screen, a printer is the output device, then the PRINT of line 2000 may simply be replaced by an LPRINT or a PRINT # command, whichever is appropriate.

The routine starting at line 1000 actually does the formatting and has two different entry points depending on whether the data item is a string or a numeric. The case of a string is the simpler of the two, so let's consider it first. To position a string you must place the string in variable N$, specify the column position (RC) against which it is to be right justified, then GOSUB 1060. Three examples of this calling sequence are given in lines 100-120. At line 1060 the program first calculates LC, the leftmost character position of the data item. Then, if the column boundaries are acceptable, it inserts N$ in LINE$ and RETURNs.

To position a numeric, you must put the data item into variable N, specify ND, the number of digits to the right of the decimal point you wish printed, specify RC as defined above, then GOSUB 1000. See lines 150-170 for examples of this calling sequence. In lines 1000-1010 N is rounded to the appropriate number of decimals. In 1020 the string N$ is defined. If the number is to be printed as an integer (ND = 0), N$ is correct as is and the jump is taken to 1060 to insert N$ into LINE$. For non-integer formats, the decimal point and any trailing zeroes which were dropped in forming the string representation of the number must be restored. This is done in lines 1030-1050. N$ is then ready for insertion into LINE$.

Output from the sample program as printed on an ATARI 820 printer (using LPRINT in 2010) is shown in Figure 1. Note that the numbers are rounded for presentation with the requested precision, that the decimal points of each column neatly line up, that all trailing zeroes are present and that negative numbers are also accommodated. Also note how easy it is to line up the column headings with the data by simply specifying the appropriate value of RC when printing them (see lines 100 & 150, 110 & 160, 120 & 170).

The routines run fairly rapidly, but if you need some extra speed, the loop in line 2010 can be avoided. To do this, dimension a string, let's call it

MT$, the same length as LINE$ and fill it with spaces just once at the start. Then, line 2010 can be replaced by **2010 LINE$ = MT$:RETURN**

If you have a slow printer like a teletype, you may also gain some speed by stripping the trailing spaces from LINE$ before printing it. This can be done by replacing line 2000 with the three lines given below.

```
2000 FOR I = NC TO 1 STEP -1:IF LINE$(I,I)<>" "
  THEN 2004
2002 NEXT I
2004 PRINT LINE$(1,I)
```

```
1 REM ** FORMATTED OUTPUT EXAMPLE **
2 REM JOE WROBEL, ROCHESTER, NY
3 REM SUBROUTINE VARIABLES - I,LC,N,NC,N
D,NZ,RC,LINE$,N$
10 NC=37:DIM LINE$(NC),N$(NC)
20 GOSUB 2010
100 N$="X":RC=7:GOSUB 1060
110 N$="X/32":RC=17:GOSUB 1060
120 N$="SIN(PI*X/8)":RC=33:GOSUB 1060
130 GOSUB 2000
140 FOR X=0 TO 15
150 N=X:ND=0:RC=7:GOSUB 1000
160 N=X/32:ND=3:RC=17:GOSUB 1000
170 N=SIN(4*ATN(1)*X/8):ND=7:RC=32:GOSUB
 1000
180 GOSUB 2000:NEXT X
190 STOP
1000 I=INT(10^ND+0.5)
1010 N=INT(I*N+0.5)/I
1020 N$=STR$(N):IF ND=0 THEN 1060
1030 IF N=INT(N) THEN N$(LEN(N$)+1)="."
1040 NZ=ND+1+LEN(STR$(INT(N)))-LEN(N$)
1050 IF NZ>0 THEN FOR I=1 TO NZ:N$(LEN(N
$)+1)="0":NEXT I
1060 LC=RC+1-LEN(N$):IF LC<=RC AND RC<=N
C AND LC>=1 THEN LINE$(LC,RC)=N$
1070 RETURN
2000 PRINT LINE$
2010 FOR I=1 TO NC:LINE$(I,I)=" ":NEXT I
:RETURN
```

X	X/32	SIN(PI*X/8)
0	0.000	0.0000000
1	0.031	0.3826834
2	0.063	0.7071068
3	0.094	0.9238795
4	0.125	1.0000000
5	0.156	0.9238795
6	0.188	0.7071068
7	0.219	0.3826834
8	0.250	0.0000000
9	0.281	-0.3826834
10	0.313	-0.7071068
11	0.344	-0.9238795
12	0.375	-1.0000000
13	0.406	-0.9238795
14	0.438	-0.7071068
15	0.469	-0.3826834

©

Random Color Switching While Idle

R. A. Howell

Have you ever been involved in a scenario similar to the following? This has happened to me several times. I get the program listing of a new game from a friend or from the pages of a magazine. The game sounds really exciting, so I anxiously begin typing the program into my Atari 800 computer system. Of course, my 10 year old son is busily watching over my shoulder because he is also anxious to try out the new program. When I finally finish, we try it. After a few corrections for typing mistakes, the game is running and we get deeply engrossed in playing it. About the time we have mastered the rules and are into the full action and excitement of the game, ZAP!!, the Atari 800 goes into its random color switching routine on the screen. This usually makes the playing field difficult to see because the random colors selected by the computer are either too dark or are all of similar shades so they blend together. The solution is simple for those of us who have used the Atari; just hit a key, any key on the keyboard and the original program's colors will be restored. Right! Wrong! The problem with this is that if I take either hand from the joystick or fire button to hit a key, my son gains the advantage in the game and vice versa. Have you also found yourself in this dilemma?

The problem occurs because of a hardware feature on the Atari computer. When a key has not been pressed for a little over 9 minutes, the system automatically starts to vary the colors on the screen. It will continue to randomly vary the colors on the screen until a key on the keyboard is pressed. At that point it will return the screen to the correct colors and begin the 9 minute time-out sequence again. The purpose of this feature is to prevent the image on the screen from being permanently burned into the phosphor on the cathode ray tube when the computer is left for a long time without being changed. However, many programs (games in particular) do not require any key-presses. All inputs come from trigger buttons and game paddles or joysticks. When running such a program, it is inconvenient to have this color switching occur every 9 minutes, so let's look at what triggers this feature and how to prevent it from happening.

Type the following one line program into your Atari computer and run it:

10 PRINT PEEK(77): GOTO 10

This program repeatedly displays the contents of RAM (Random Access Memory) location 77 on the screen. As you can see by watching it run, RAM location 77 starts at 0 and increments by 1 every 4 to 4.5 seconds. Now while this program is still running, press any key on the keyboard (except BREAK or the 4 special function keys). As soon as you pressed the key, notice that location 77 returned to 0 and started incrementing all over again. Now let the program run for a while without pressing any keys. After approximately 9 minutes, the count will be close to 128. As soon as RAM location 77 reaches 128, you will see that it gets set to 254 and the screen colors immediately begin to vary randomly. Now with the program still running, press any key again. Normal colors are returned to the screen and location 77 begins all over incrementing from 0.

Each byte of memory in the Atari consists of 8 BITS (BInary digiTS - 1's or 0's). The lower 7 bits of memory location 77 are used to count from 0 to 127. When the count reaches 127, all of these 7 bits are binary 1's. Adding 1 more causes the 8th (uppermost) bit to change from 0 to 1 and this triggers the random color switching hardware. At 4 to 4.5 seconds per increment, it takes about 9 minutes for the computer to count from 0 to 127. Any number in location 77 from 128 to 255 will cause the upper bit to be set to 1 and the random color switching to occur. To see this, stop the program from running (with the BREAK key) and enter the following:

POKE 77,217

When you type this and press RETURN, the screen immediately starts switching colors because 217 is between 128 and 255 and has caused the upper bit of memory location 77 to be set to 1.

So any BASIC program can be modified to prevent the random color switching from occurring by periodically executing a POKE 77,0 to reset location 77 to zero and prevent it from reaching 128. Now you say, 'Won't this stop the computer from doing its color switching if I leave it for over 9 minutes with that program running and thus defeat the purpose of this hardware feature?' The answer is no, not if the POKE statement is placed in the program properly. When the program is idle, it will probably be in a loop waiting for paddle or joystick inputs. Just make sure the POKE statement is not put in this loop. Place it elsewhere in the program where it will be executed frequently. Then, if the computer is left idle while the program is running, it will not execute the POKE statement and random color switching will take place after 9 minutes. When the player returns, as soon as the joystick or paddle is moved or a trigger button pressed, the idle loop will be terminated and the POKE statement executed, returning the screen to normal colors. If the POKE statement is put in the right place, it can be made to appear as if the paddle or joystick acted just like a keypress in restoring the screen to normal.

Now that the function of RAM location 77 has been revealed, the random color switching feature of the Atari computer can be put back into its proper place. It won't need to be a bother any longer by popping up unexpectedly at the wrong moment! Happy programming. ©

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THE OSI® GAZETTE

A Small Operating System: OS65D The Kernel

Part 3 of 3

Tom R. Berger
School of Math
University of Minnesota
Minneapolis, MN

Concluding Remarks

OS65D is a very small operating system. It is in no sense 'generalized' to run with a large variety of software or peripherals as, say, Digital Research's CP/M is for the Z80. If software and peripherals other than those supplied by OSI are to be used, then the operating system must be modified. There are advantages and disadvantages to such an operating system. Disadvantages result from its inherent inflexibility and lack of generalized commands. On the other hand, because the operating system is so very small and easy to understand, for those who choose to understand it, it is easy to modify to suit personal needs: a definite advantage.

Let's look now at some 'features' not available in OS65D. Essentially all the operating system is in memory at all times. This creates minor problems with peripherals and INPUT/OUTPUT. For example, the original conception by OSI of I/O leads to a sequence of routines exactly filling the I/O space. Time has shown that OSI did not make the perfect choice for all situations. In particular, the real time version of OS65D requires that certain of the I/O routines be partially overlaid or omitted to make room for expansions of other I/O routines. The missing routines are not easily returned except by special allocation. A more generalized system would have an area of memory for I/O routines (just as OS65D does), but this area would not have fixed routines in it. I/O routines would be written to run at any location and would be loaded into the special space from the disk when they were needed, and where a niche was available. After they had served their purpose, the space they occupy would become available for other routines. This 'generalized' approach eases I/O problems, but requires much additional coding to handle all the loading and space allocation.

The disk handling routines could not be made much more compact. In particular, many user functions are left out. Thus the user must do a large amount of housekeeping not required on larger systems. The most glaring deficiency is the file creation process. You cannot create a file until you know its size. Usually, you cannot know its size until it is in memory; but the file creation utility occupies the same space as the file. As a result, a scratch file must be created in order to temporarily save programs while a permanent file of the correct size is created. The process becomes even more involved if you wish to expand a current file beyond its current size.

If you use BASIC programs which process many files, then the error recovery process of OS65D is far too simple. If BASIC calls an operating system command (say DISK!"blah blah") and an error occurs, this error is often nonrecoverable. That is, the stack is reset and return to BASIC occurs through the WARM START. This often means your program will bomb if you try to CONTINUE. If you have a large amount of information stored in BASIC strings and in the process of saving it encounter a disk error, then without a great deal of knowledge about the internal working of BASIC, your information is lost.

Most file handling is done with BASIC utilities. If you are programming in assembly language, this leads to endless shuffling back and forth from BASIC to the Assembler and back.

The operating system lacks an adequate editor. Thus the Assembler and BASIC must contain their own editors. As a consequence, all input must be acceptable to one of these two editors if it is to be processed. In particular, line numbers are needed. A

BASIC program can be created to solve this numbering problem, but BASIC may be too slow. Solving this new problem leads to further complications which would not be necessary with a good operating system editor.

There are certain philosophical advantages to a small operating system. OS65D is small enough that its entire operation can be understood at once. This means hackers can modify and alter the system, not just by POKES and patches, but fundamentally, to suit their own needs. In my experience, most hobby OSI computer owners aspire to or already fall in this hacking category. The smallness of the system puts the user in direct contact with the most fundamental operating system commands and operations. Even though it is slightly more involved, this gives the user the very maximum of control over the system.

This article was written using disassemblies of OS65D V3.2 (NMHZ) Release November 1979. Future articles will cover: (1) the I/O routines; (2) the Disk routines; (3) the ROM, and (4) miscellaneous bits and pieces. The disassemblies I have made are fully annotated (by hand) and are available for those who would like to use them. Send a stamped, self-addressed postcard to me to determine availability.

Tom Berger
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A Six-Gun Shootout Game For The OSI C1P

Charles L. Stanford

The Six Gun Shootout game is a very pleasant and fun activity, particularly for the six to twelve or so age group. But this article concerns more than just the mechanics of writing another BASIC game for the C1P. When I originally wrote the program almost two years ago, we were reasonably satisfied with it. Sure, it was slow. Every time a player moved his gunfighter up or down the screen, the graphics POKEs took a lot longer than desired. And remembering that the "1" key was UP and the "2" key was down took a lot away. Those of you who have seen my articles on Fast Graphics (COMPUTE II Issue 3) and on interfacing the Atari Joystick to the C1P (COMPUTE Issue 7) can grasp what happened. Making that program work like it should has taught us more about the workings of the machine, over the past year, than any dozen manuals or articles.

This article, then, is a summing up of the methods we used to speed up both the software and the hardware to make BASIC games both more fun and much more saleable in the not inconsiderable Software marketplace.

BASIC Program Description

The game runs much as the early Arcade versions did. Each player has his gunfighter, who can shoot across the screen. Three Cacti obstruct some of the view, and move to a new location after each shot. Each player can move up or down, and shoot. Each gets 15 shots, and 5 hits wins.

The BASIC program shown in Listing 1 is fairly well annotated with REMs, but a few of the routines bear some discussion. The initialization starting at Line 5 sets the screen up as though no joysticks were available. This was deliberate, and makes the game more universally useful. It is a good idea to do this on all games, whether for paddles or for joysticks. The scoring from Line 200 is handled indirectly through the Fast Graphics Machine Language subroutine. Thus the POKEs of the ASCII characters are to that program rather than to the

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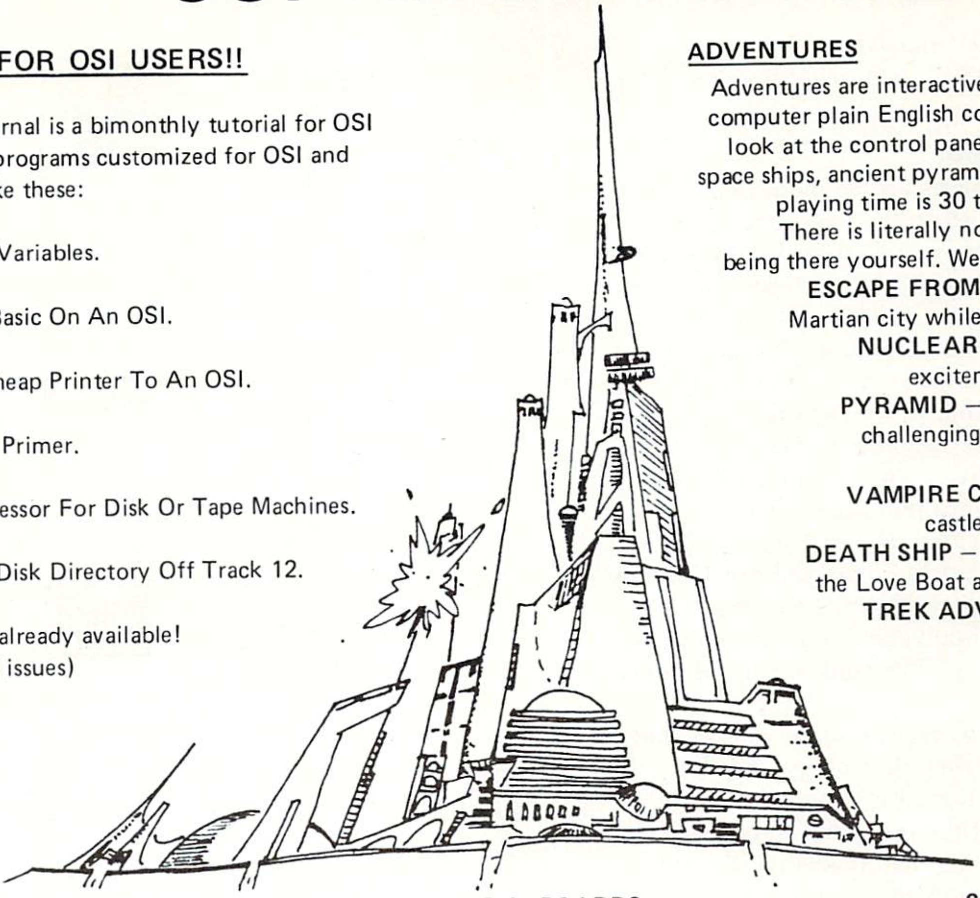

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screen. One routine, the "man dead" sequence, is still done in BASIC POKEs as a delay is called for here anyway.

The Joystick Interface

As described in the previous article mentioned above, the joysticks are interfaced to the keyboard such that any position can be directly related to the pressing of one or two keys. While the Atari Joysticks have eight positions around the center, only two of them are used in this game, and the others are "masked" out of existance. This is done with the routines beginning at Lines 700 and 750. Line 710's POKE K, 127 activates only Row 7 of the Keyboard. The first statement of Line 720 ORs away any columns except 5, 4, and 3, by forcing 1s into the others. Thus only keys 3, 4, and 5 are accepted as valid inputs. The next two statements of that line mask all but Column 5, so that a "shoot" command gets precedence over a "move" command. Finally, the other two keys are examined in Lines 725 and 730, and one of the move routines is addressed.

The routine at 750 works the same, except that Row 6 is activated, and the other player gets his chance. Each player is queried in turn, so one guy can't stand there and fill the other full of holes. The joystick works the same way as the keyboard, and is certainly a lot easier to use without a lot of practice, especially by the younger players.

Fast Graphics for the Six Gunners

The machine language graphics is done exactly the same way as the Choo Choo Collision demonstration program of the other previous article. A standard routine, shown in Listing 2, addresses a table of graphics symbols. These symbols are tailored for any game or other graphics screen display as shown in Figure 1. First, the Graphics Reference Manual is used to "draw" the characters desired, using a grid of sufficient size. Don't worry about screen location. The BASIC program takes care of that, by POKEing the table. Just lay out the characters, Determine the addresses of each of the elements of each character relative to the upper left corner of its grid, and couple that with the character code in making up the table. Each character should be ended with an #$FE (if there are more characters) or an #$FF (for the last character, or to end the routine).

Going Farther

You can just enter this program as-is, and have another nice game for your collection. Or you can dig a lot deeper, and quite possibly learn some techniques that will improve both your programming ability and some of those other games that run a bit slow, or get tiresome because the keyboard sequence is hard to use and remember. Anyone wishing to gain a deeper understanding of either the hardware or the software concepts described here should most certainly look to the other articles referenced.

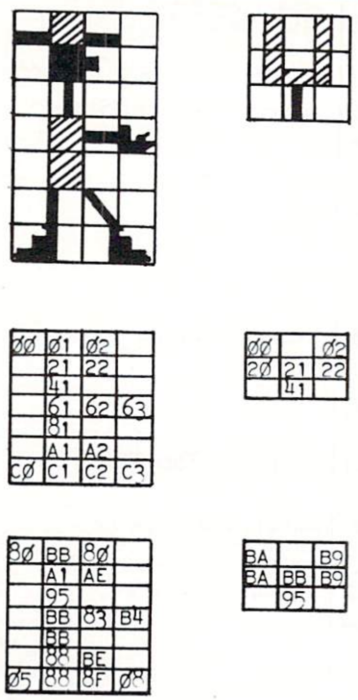


Figure 1. Graphics Development

Listing 1. Basic Program

```
5 FORS=ØTO9:PRINT:NEXT
7 REM-FOR ATARI JYSTKS
1Ø PRINT" SIX-GUN DUEL GAME
15 PRINT:PRINT:PRINT
2Ø PRINT"LEFT","RIGHT"
25 PRINT"----","-----
3Ø PRINT"  4      UP","    :
35 PRINT:PRINT"  3      DOWN","   Ø
4Ø PRINT:PRINT"  5      SHOOT","   -
45 PRINT:PRINT:PRINT"YOU HAVE 15 SHOTS EACH.
5Ø PRINT:PRINT:PRINT"FIVE HITS WINS!
55 PRINT:PRINT:PRINT"HIT SPACEBAR TO START
6Ø GOSUB1ØØ
65 GOSUB8ØØ
7Ø Z=1:L=Ø:R=Ø:SL=15:SR=15
75 POKE53Ø,1:K=57ØØ8:C=53445:D=54ØØ9
8Ø POKEK,253:IFPEEK(K)=239THEN9Ø
85 GOTO8Ø
9Ø X=USR(X):GOSUB2ØØ
95 GOTO7ØØ
1ØØ REM-MACH GRAPHICS
11Ø RESTORE
115 POKE11,34:POKE12,2:POKE254,96:POKE255,2
12Ø FORP=ØTO61:READM:POKE546+P,M:NEXT
13Ø DATA16Ø,Ø,169,32,153,Ø,211,153,Ø,21Ø,153,Ø,2Ø9,153,Ø
135 DATA2Ø8,2ØØ,2Ø8,241,234,234,234,16Ø,Ø,177,254,141,86,2,2ØØ
14Ø DATA177,254,141,87,2,2ØØ,177,254,17Ø,2ØØ,224,254,24Ø,236,224,255
145 DATA24Ø,8,177,254,2ØØ,157,68,2Ø9,2Ø8,236,96,234,234,234,234,234
148 REM-FIGURES NEXT
149 POKE133,255:POKE134,31:FORP=ØTO152:READM:POKE6Ø8+P,M:NEXTP
15Ø DATA197,2Ø8,Ø,128,1,187,2,128,33,161,34,174,65,149,97,187
155 DATA98,131,99,18Ø,129,187,161,136,162,19Ø,192,5,193,136,194,143
16Ø DATA195,8,254,17Ø,2Ø8,Ø,186,2,185,32,186,33,184,34,185,65
165 DATA149,254,174,2Ø9,Ø,186,2,185,32,186,33,184,34,185,65,149
17Ø DATA254,178,21Ø,Ø,186,2,185,32,186,33,184,34,185,65,149,254
175 DATA249,21Ø,1,128,2,187,3,128,33,173,34,161,66,149,96,181
18Ø DATA97,131,98,187,13Ø,187,161,189,162,143,192,5,193,136,194,143
185 DATA195,8,254,136,211,Ø,49,1,53,4,48,1Ø,48,13,49,14
19Ø DATA53,255,255,255,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø
195 DATAØ,1,2,3,4,5,6,7,8,9,1Ø,11,12,13,14,15
199 RETURN
2ØØ REM-SCORE
21Ø POKE73Ø,48+L:POKE732,48+R
22Ø IFL=5ORR=5THEN29Ø
23Ø M=INT(SL/1Ø):N=SL-M*1Ø:IFM=ØTHENM=-16
24Ø U=INT(SR/1Ø):V=SR-U*1Ø:IFU=ØTHENU=-16
25Ø POKE726,48+M:POKE728,48+N
26Ø POKE734,48+U:POKE736,48+V
27Ø IFSL=ØANDSR=ØTHEN29Ø
28Ø RETURN
29Ø X=USR(X):GOTO6Ø
3ØØ REM-LEFT MAN DEAD
3Ø5 C=C+16Ø
31Ø POKEC+2,32:POKEC-31,32:POKEC-61,32:POKEC-62,32:POKEC-63,32
315 POKEC-95,32:POKEC-126,32:POKEC-127,32:POKEC-158,32:POKEC-159,32
32Ø POKEC-16Ø,32
325 POKEC,143:POKEC+1,171:POKEC+3,14Ø
33Ø POKEC+32,187:POKEC+33,161:POKEC+34,148
335 POKEC+35,187:POKEC+36,187:POKEC+37,128
34Ø POKEC+38,176:POKEC+64,143
345 FORT=ØTO5ØØ:NEXT:C=C-16Ø:RETURN
35Ø REM-RIGHT MAN DEAD
355 D=D+158
36Ø POKED+3,32:POKED+4,32:POKED-28,32:POKED-6Ø,32:POKED-61,32
365 POKED-62,32:POKED-92,32:POKED-124,32:POKED-125,32
```

```
370 POKED-155,32:POKED-156,32:POKED-157,32
375 POKED+3,139:POKED+5,171:POKED+6,136
380 POKED+32,178:POKED+33,128:POKED+34,187:POKED+35,187
385 POKED+36,148:POKED+37,161:POKED+38,187
390 POKED+70,136
395 FORT=0TO500:NEXT:D=D-158:RETURN
400 IFSL=0GOTO750
405 Q=0
410 FORX=1TO3
415 IFC<E(X)-32ANDC>E(X)-128THENG=2:GOTO445
420 NEXT
425 IFC<D-96ORC>D+32THENG=23:GOTO445
430 G=23:GOSUB460
435 GOSUB350
440 L=L+1:GOTO450
445 GOSUB460
450 SL=SL-1
455 GOSUB800:GOSUB200:GOTO690
460 FORX=C+100TOC+100+G
465 POKEX,45
470 NEXT
475 FORT=0TO200:NEXT
480 RETURN
500 IFSR=0GOTO700
505 Q=1
510 FORX=1TO3
515 IFD<E(X)ANDD>E(X)-96THENG=2:GOTO545
520 NEXT
525 IFD<C-64ORD>C+64THENG=23:GOTO545
530 G=23:GOSUB560
535 GOSUB300
540 R=R+1:GOTO550
545 GOSUB560
550 SR=SR-1
555 GOSUB800:GOSUB200:GOTO640
560 FORX=D+94TOD+94-GSTEP-1
565 POKEX,45
570 NEXT
575 FORT=0TO200:NEXT
580 RETURN
600 REM-LEFTMOVE
610 Q=0:IFC<53443THEN750
620 C=C-32:GOTO640
630 Q=0:IFC>54019THEN750
635 C=C+32
640 H=C:GOSUB900:POKE609,J:POKE608,M:X=USR(X):IFQ=1THEN700
645 GOTO750
650 REM-RIGHTMOVE
660 Q=1:IFD<53443THEN700
670 D=D-32:GOTO690
680 Q=1:IFD>54019THEN700
685 D=D+32
690 H=D:GOSUB900:POKE689,J:POKE688,M:X=USR(X)
695 IFQ=0THEN750
700 REM-LEFT INPUT
710 POKEK,127
715 Y1=PEEK(K)
720 Y1=Y1OR199:Y2=Y1OR247:IFY2=247THEN400
725 IFY1=239THEN600
730 IFY1=223THEN630
735 GOTO750
750 REM-RIGHT INPUT
760 POKEK,191
765 Z1=PEEK(K)
770 Z1=Z1OR199:Z2=Z1OR247:IFZ2=247THEN500
775 IFZ1=239THEN650
780 IFZ1=223THEN680
785 GOTO700
800 REM-CACTUS LOCATOR
810 EE=53414
820 FORX=1TO3
830 E(X)=EE+32*INT(22*RND(1))
840 E(X)=E(X)+X*4
850 H=E(X):GOSUB900
860 ONXGOSUB870,880,890
865 NEXTX:RETURN
870 POKE644,J:POKE643,M
875 RETURN
880 POKE659,J:POKE658,M
885 RETURN
890 POKE674,J:POKE673,M
895 RETURN
900 REM-CHAR LOC SUB
910 J=INT(H/256)
920 M=H-J*256
930 RETURN
990 END

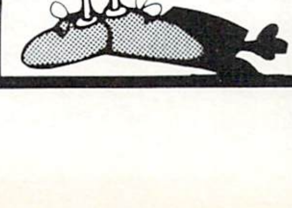
OK
```

```
0222 A0 00     LDY,I
0224 A9 20     LDA,I
0226 99 00 D3  STA,A,Y
0229 99 00 D2  STA,A,Y
022C 99 00 D1  STA,A,Y
022F 99 00 D0  STA,A,Y
0232 C8        INY
0233 D0 F1     BNE
0235 EA        NOP
0236 EA        NOP
0237 EA        NOP
0238 A0 00     LDY,I
023A B1 FE     LDA,(I),Y
023C 8D 56 02  STA,A
023F C8        INY
0240 B1 FE     LDA,(I),Y
0242 8D 57 02  STA,A
0245 C8        INY
0246 B1 FE     LDA,(I),Y
0248 AA        TAX
0249 C8        INY
024A E0 FE     CPX,I
024C F0 EC     BEQ
024E E0 FF     CPX,I
0250 F0 08     BEQ
0252 B1 FE     LDA,(I),Y
0254 C8        INY
0255 9D 88 D3  STA,A,X
0258 D0 EC     BNE
025A 60        RTS
```

Listing 2. Machine Language Subroutine

```
0260  C5 D0        02A1  92 D1
0262  00 80        02A3  00 BA
0264  01 BB        02A5  02 B9
0266  02 80        02A7  20 BA
0268  21 A1        02A9  21 B8
026A  22 AE        02AB  22 B9
026C  41 95        02AD  41 95
026E  61 BB        02AF  FE
0270  62 83        02B0  F9 D2
0272  63 B4        02B2  01 80
0274  81 BB        02B4  02 BB
0276  A1 88        02B6  03 80
0278  A2 BE        02B8  21 AD
027A  C0 05        02BA  22 A1
027C  C1 88        02BC  42 95
027E  C2 8F        02BE  60 B5
0280  C3 08        02C0  61 83
0282  FE           02C2  62 BB
0283  8A D1        02C4  92 BB
0285  00 BA        02C6  A1 BD
0287  02 B9        02C8  A2 8F
0289  20 BA        02CA  C0 05
028B  21 B8        02CC  C1 88
028D  22 B9        02CE  C2 8F
028F  41 95        02D0  C3 08
0291  FE           02D2  FE
0292  2E D2        02D3  88 D3
0294  00 BA        02D5  00 31
0296  02 B9        02D7  01 35
0298  20 BA        02D9  04 30
029A  21 B8        02DB  0A 30
029C  22 B9        02DD  0D 31
029E  41 95        02DF  0E 35
02A0  FE           02E1  FF
```

Listing 3. Machine Language Graphics Table ©



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Keyprint Revisited

Eric Brandon
Islington, Ontario
Canada

When I first saw KEYPRINT by Charles Brannon in the NOV/DEC 1980 issue of COMPUTE! I thought my printer problems were over. Not so! As I read on, I discovered that KEYPRINT was only for the new upgrade ROMs, and I had the old original ROMs. Furthermore, I knew no machine or assembly language. I could:

a) Get new ROMs (and give up half my program library).

b) Learn assembly language and modify KEYPRINT for the old PETs.

c) Give up.

I chose solution b. I purchased books, assemblers, disassembler, and all the paraphenalia associated with assembly language programming. Here is the result of my efforts: KEYPRINT for old ROM PETs.

```
C*    PC   SR AC XR YR SP
.;   C6ED 00 38 00 32 FE
.    M 033A 03CF
          0  1  2  3  4  5  6  7
.:   033A 78 A9 03 8D 1A 02 A9 47
.:   0342 8D 19 02 58 60 AD 03 02
.:   034A C9 45 D0 03 20 54 03 4C
.:   0352 85 E6 A9 80 85 20 A9 00
.:   035A 85 1F A9 04 8D 64 02 85
.:   0362 F1 20 BA F0 20 32 F1 A9
.:   036A 19 85 22 A9 0D 85 21 20
.:   0372 D2 FF A9 11 AE 4C E8 E0
.:   037A 0C D0 02 A9 91 20 D2 FF
.:   0382 A0 00 B1 1F 29 7F AA B1
.:   038A 1F 45 21 10 0B B1 1F 85
.:   0392 21 29 80 49 92 20 D2 FF
.:   039A 8A C9 20 B0 04 09 40 D0
.:   03A2 0E C9 40 90 0A C9 60 B0
.:   03AA 04 09 80 D0 02 49 C0 20
.:   03B2 D2 FF C8 C0 28 90 CB A5
.:   03BA 1F 69 27 85 1F 90 02 E6
.:   03C2 20 C6 22 D0 A6 A9 0D 20
.:   03CA D2 FF 4C CC FF 67 54 00
      \
.
```

First, type in the hexadecimal (base 16) code with your monitor. If you don't know how to do this, consult your (or anyone else's PET manual.

Once you have entered it, type:

M 033A 03CF

and compare what you see with what is on this page. If they don't correspond exactly, either fill in what doesn't match (remember to hit RETURN at the end of each line), or start over.

When KEYPRINT is in memory correctly, type:

S 01, KEYPRINT, 033A, 03CF

to save it on tape.

An 'X' command will get you out of the monitor. Type:

SYS 826

to initialize KEYPRINT. The cursor should reappear almost instantly. If it doesn't, you have made a mistake in the first 12 bytes (numbers). LOAD it, and check again.

Hopefully, your cursor came back. If it did, hit the '\' key and your screen should be dumped on the printer. If it doesn't, you have made one of the following mistakes:

a) Typing error.
SOLUTION: Start again.

b) Your printer has a secondary address other than 4. SOLUTION: POKE 861,SA

c) You forgot to initialize.
SOLUTION: SYS 826 and hit the key again.

d) You hit the wront key.
SOLUTION: Hit the key to the right of the ampersand.

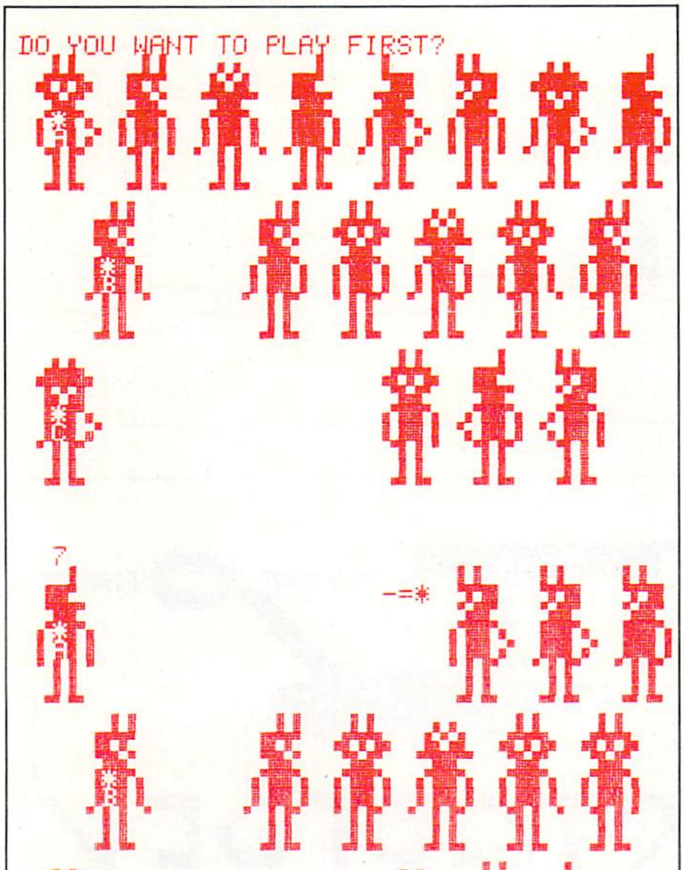
e) You tried this program on something other than an old ROM PET.
SOLUTION: Move on to the next article.

You can also make KEYPRINT work without hitting a key (it doesn't even have to be initialized) with an SYS 852.

When KEYPRINT is active (hitting '   ' will make it work), the PET will neither LOAD nor SAVE properly. There are two ways of deactivating KEYPRINT:

a) POKE 537,133:POKE 538,230

b) Typing LOAD or ◄SHIFT► RUN/STOP, pushing PLAY, FAST FORWARD, or REWIND on the cassette and BREAKing it with the stop key. If the cassette motor doesn't run before you BREAK the LOAD, KEYPRINT will not be deactivated.



KEYPRINT can always be revived with an SYS 826.

Finally, memory location 843 contains the number representing the key that must be hit to dump the screen. To change the key, Type:

FOR T = 1 TO 1E6:PRINT PEEK(515):NEXT T

You will see a column of 255s going up the screen. Hit the key you wish to assign as THE key. The 255s will change into another number, Remember that number. BREAK the loop with the STOP key, and POKE 843,n where n is the number you saw

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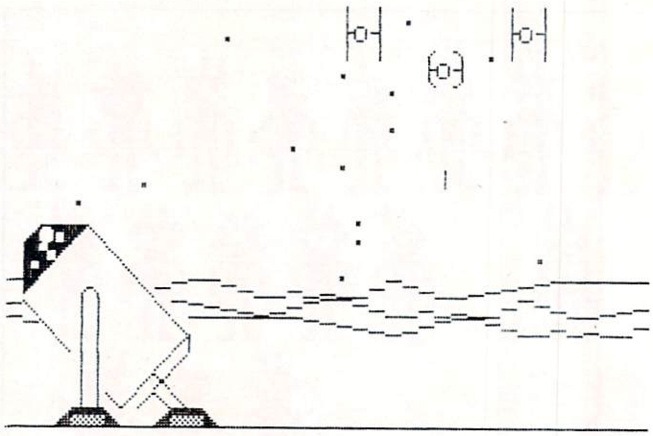
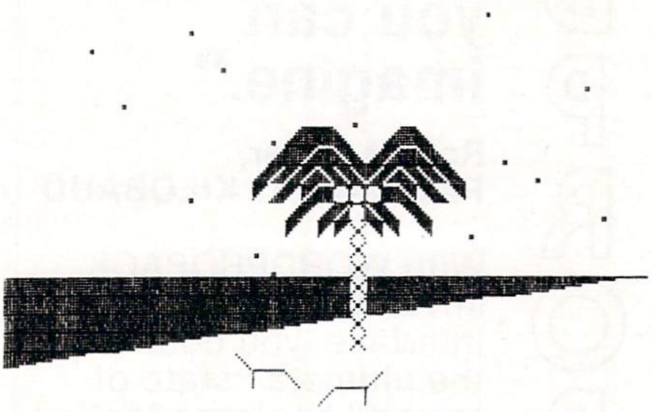
when you hit the key.

I hope you find the program useful. I would like to thank Jim Butterfield for sharing some memory locations with me. If anyone wishes more information on the program, or if anyone wants to trade their programs with me please write to:

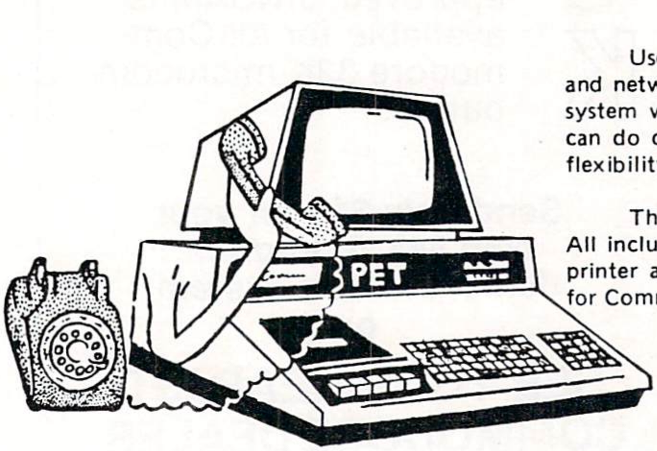
Eric Brandon
36 Hartfield Road
Islington, Ontario, Canada
M9A 3C9





PETTERM

Terminal Program



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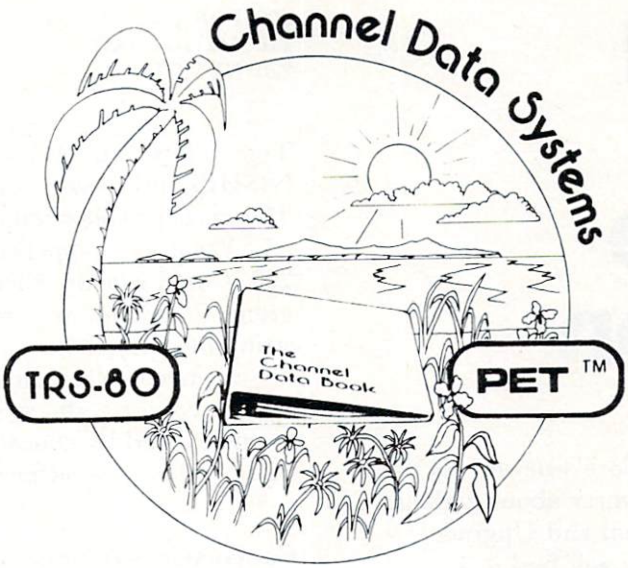

OMNIFILE CBM or TRS-80 $30

Omnifile is a versatile, in-memory database program with sorting, formatting, and computational features. Records can be entered, edited, and processed with a single letter command. **Omnifile** applications include inventory records, mailing lists, sales journals and collection lists. Records can be stored on the Commodre floppy disks or on the tape cassette. **Omnifile** uses approximately 6k of RAM memory. Up to 500 records can be contained in memory in a 32k CBM at any time. Multiple files are easily accessed from disk or tape. Items can be sorted, moved, inserted and reformatted. Calculations can be made and totals can be printed. The **Omnifile** package includes the program with sample data, listing and manual, and will operate on the large keyboard Commodore PET or CBM computers with at least 16k memory. Also available on diskette for $36. An abbreviated version, **Data Logger,** requiring only 1k of RAM is available on cassette for $15.

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General Ledger is a complete double entry bookkeeping system with provisions for budgeting and keeping records of income, deductible and non-deductible expenses, assets and liabilities. Simple interactive features allow entering transactions, adding or editing accounts, and printing of a detailed income statement and balance sheets. Data can be stored on the Commodore floppy disks or cassette. **General Ledger** occupies about 6.2k of RAM memory, allowing approximately 200 accounts on a 16k machine. Transaction files can be accessed by our **Omnifile** database program for complete analysis, sorting by date, account number, etc. The **General Ledger** program will operate on the new Commodore PET or CBM microcomputer systems and comes with sample data, listing, and manual. Also available on diskette for $36. An abbreviated version allowing about 35 accounts on a 1.0 or 2.0 BASIC 8k PET is available on cassette for $20.

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CHANNEL DATA BOOK for PET CBM $20

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Learning About Garbage Collection

Jim Butterfield

If you are blessed with Commodore's newest ROM 4.0 system, you won't need to worry about garbage collection. But users with Original and Upgrade ROMs will run into it, and they will find it worthwhile to learn more about how it works.

Garbage collection is misnamed. It should be called garbage disposal or preferably memory reclaiming. Whatever you call it, the symptoms are highly visible and annoying: a long pause during which the computer appears to be dead.

There are methods to overcome many garbage collection delays. First, however, it's worthwhile looking into what causes it and how it behaves. We'll perform a series of experiments to disclose the characteristics of garbage collection.

Part 1: Experiments

Type in the following program:

```
100 DIM A$(255)
110 FOR J = 1 TO 255
120 A$(J) = "A" + "B"
130 NEXT J
500 REMARK: FORCE COLLECTION WITH FRE(0)
510 PRINT "STARTING"
520 Z = FRE(0)
530 PRINT "FINISHED"
```

Type RUN. There will be a pause of over five seconds between the printing of the words STARTING and FINISHED. This is the infamous garbage collection pause; while it's in progress, the RUN/STOP key doesn't work and the computer appears to be dead.

Note that there is in fact no garbage to be collected: all the strings we have manufactured are still live. But the delay is still there.

Conclusion #1: *You can have substantial garbage collection delays even when you have little or no garbage.*

Now that the program has run, type GOTO 500. Garbage collection will take place again on the same strings. It's just as long as the first time.

Conclusion #2: *You don't save time on a garbage collection even though your strings were collected recently.*

Add the following lines to the above program:

```
200 FOR J = 1 TO 255
210 A$(J) = "AB"
220 NEXT J
```

Type RUN. The words STARTING and FINISHED print with very little delay between them. The garbage collection delay has vanished!

What has happened here? The string AB in line 210 is used exactly where it lies in the Basic program; there's no need to repack it into "dynamic string memory". As a result, this type of string doesn't need collection.

In contrast, the string built in line 120 had to be manufactured by concatenation, and thus needed to be stored in general memory.

Conclusion #3: *Strings supplied within the program don't contribute to garbage collection delays. This also applies to strings supplied within DATA statements.*

If you listed the program as we have run it so far, you'll see that we have created a good deal of garbage. All of the strings generated by line 120 were later thrown away and replaced by the strings in line 210. Yet there was almost no garbage collection delay.

Conclusion #4: *Garbage (abandoned strings) don't contribute much to garbage collection delay. Only the strings you keep cost you time.*

Now let's change two lines of our program to increase the number of strings we are generating. Change the following lines:

```
100 DIM A$(255), B$(255)
  .. .. .. .. ..
210 B$(J) = LEFT$("HELLO",4)
```

This time, we're going to manufacture twice as many strings. Should we expect the garbage collection time to double over our previous five seconds?

Type RUN and see.

This time, garbage collection took over twenty seconds.

Conclusion #5: *Garbage collection time is proportional to the square of the number of dynamic (manufactured) strings.*

Now for the final experiment. Type in the following lines:

Original ROM:

```
450 X1 = PEEK(134) : X2 = PEEK(135)
460 Y1 = PEEK(130) : Y2 = PEEK(131)
470 POKE 134,Y1 : POKE 135,Y2
600 POKE 134,X1 : POKE 135,X2
```

Upgrade ROM:

```
450 X1 = PEEK(52) : X2 = PEEK(53)
460 Y1 = PEEK(48) : Y2 = PEEK(49)
470 POKE 52,Y1 : POKE 53,Y2
600 POKE 52,X1 : POKE 53,X2
```

What will these additions do? Just before garbage collection begins, it sets the top-of-Basic memory

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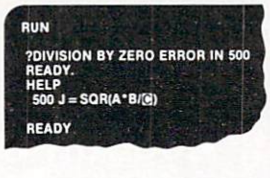

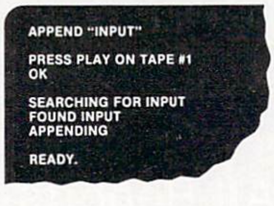

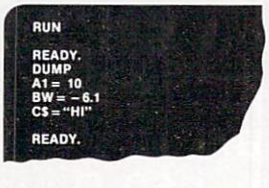

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```
 100 GOSUB 180
 105 PRINT USING C$, A, B$
 130 INPUT "TIME", D$
 131 INPUT "DAY", E$
 160 IFB<>C THEN 105
 180 FOR X=IT09
 183 PRINT Y(X):NEXT
 184 RETURN
 200 I=X/19
READY

RENUMBER 110, 10, 105-184

READY
LIST
 100 GOSUB 150
 110 PRINT USING C$, A, B$
 120 INPUT "TIME", D$
 130 INPUT "DAY", E$
 140 IFB<>C THEN 110
 150 FOR X=IT09
 160 PRINT Y(X):NEXT
 170 RETURN
 200 I=X/19
READY
```

```
MERGE D1 "BUY NOW*"

SEARCHING FOR BUY NOW*
LOADING

READY
RENUMBER 100, 10

READY
FIND B$
110 PRINT USING A$, B$, B$+C$+D$
280 B$="NOW IS THE TIME"

READY
```

```
 580 BA=BA- 1
 590 RA=123*5X/92+BA*10
 600 IF BA=143 THEN 580
 610 RETURN
 620 C$="PROFIT $#, ###.## DAILY"
 630 PRINT USING C$, PI
 640 D$="LOSS  $#, ###.## DAILY"
 650 PRINT USING D$, LI

RUN

PROFIT $1, 238.61 DAILY
LOSS  $     0.00 DAILY

READY
```

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pointer lower. After garbage collection completes, it restores the pointer to its original value.

There are the same number of strings as previously, so it seems that garbage collection time should not be affected, and should stay at twenty seconds or so.

Type RUN. Surprise! Garbage collection time drops to zero!

Conclusion #6: *Garbage collection is not performed on strings located above the top-of-Basic-memory.*

The strings are not affected — but no garbage collection took place up there either, so that unwanted strings would not be discarded.

Part 2: Techniques For Reducing Garbage Collection Time

Case 1: Eliminating concatenation garbage.

Suppose we're inputting a string and using concatenation to put it together. Sample coding might be:

```
800 REMARK: INPUT STRING
810 A$ = "" : rem start with null string
820 GET B$: IF B$ = "" GOTO 820
830 IF B$ = CHR$(13) GOTO 850
840 A$ = A$ + B$ : GOTO 820
850 REMARK: A$ CONTAINS OUR INPUT
```

The problem here is that this type of concatenation lays waste a lot of memory. If our input is HELLO, ROBERT, the variable A$ will first be set to H, then to HE and so on until the full thirteen characters are received. Over seventy locations will end up containing abandoned strings; and if our input string were fifty characters long we'd create over a thousand bytes of garbage. This kind of thing can trigger automatic garbage collection very quickly.

A little perspective: if A$ and B$ were our only string variables, we'd have nothing to worry about. Garbage collection would be almost instantaneous. But if we had hundreds of other strings lying about, they would all go through the collection process, and we'd be in time trouble.

Solution: Before we enter this string-wasting routine, insert (at line 805) coding to move the top-of-Basic-memory pointer down. Let the concatenation program run; when it is finished (line 850), force a tiny collection with Z = FRE(0) and then restore the top-of-Basic-memory pointer. Refer back to the experiments for the technique.

Case 2: Reading in a batch of new strings from a file.

Suppose we read in a whole flock of strings dealing with a customer account and place them in one or more arrays. No problem so far: the strings will read in neatly from a file and there will be little waste space.

Now assume that we've finished with that customer and the program goes back to read in material for the next account. Danger! The old strings are still there, taking up waste space. As we read in new material, we may run short of room, and garbage collection will automatically be called in. It will collect the new strings and quite a few of the old ones that we haven't discarded yet. Help!

Solution: Get rid of the old strings as soon as they are not needed by setting them to null strings (e.g., A$(J) = ""). Then, when your strings are at a minimum — just before reading in the new batch — force a collection with Z = FRE(0). Collection will be quick, since there are few live strings left, and the new information will read into freshly liberated memory.

Case 3: Shuffling strings around

There are times when you have a lot of strings in an array, and you want to change their order. The most usual case is that you want to sort them into some kind of order.

To exchange strings four and seven, you would tend to code something like:

```
700 X$ = X$(4)
710 X$(4) = X$(7)
720 X$(7) = X$
```

Unfortunately, this simple swap leaves three abandoned strings in memory: the old value of X$(4), the old value of X$(7), and X$, which will probably not be used again. We don't need to do much of this before garbage collection kicks in again.

Solution: Use a technique called an index array. Instead of changing the strings and causing garbage, change the index instead. The above coding will change to:

```
700 I% = I%(4)
710 I%(4) = I%(7)
720 I%(7) = I%
```

We must be careful to set up array I% at the start, so that I%(4) = 4, for example. At any time, we can call up string number four by referring to X$(I%(4)). Here's a simple example:

```
100 REMARK: SIMPLE BUBBLE SORT
110 DIM N$(20),I%(20)
120 PRINT "INPUT 20 NAMES:"
130 FOR J = 1 TO 20
140 I%(J) = J      : rem set up index
150 INPUT N$(J)    : rem get string input
160 NEXT J
200 F = 0
210 FOR J = 1 TO 19
220 IF N$(I%(J))< = N$(I%(J + 1))GOTO 250
230 F = 1
240 I% = I%(J) : I%(J) = I%(J + 1) : I%(J + 1) = I%
250 NEXT J
260 IF F = 1 GOTO 200
300 FOR J = 1 TO 20 : PRINT N$(I%(J)) : NEXT J
```

You can see that we never move a string, but the sort is performed. ©

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Pet Machine Language Graphics

David Malmberg, Fremont, CA

The PET has great graphics for almost any application, especially games. The only drawbacks I have found are that sometimes the graphics are not fast enough, or certain special effects (such as reversing only a section of the screen) cannot be done easily or quickly in a BASIC program without resorting to writing special subroutines in machine language. After many frustrating attempts to get the graphics to do exactly what I wanted in various machine language routines, I decided to write a general machine language subroutine that could be easily called from a BASIC program and would give the PET a wide-ranging repertoire of graphics "tricks."

Listing 1 is a BASIC program that POKEs this general machine language subroutine into the second cassette buffer and into the top three pages (a page is 256 bytes) of memory. This program then resets the memoy boundaries to protect the machine code from any BASIC programs. This is done automatically and is independent of the memory size. The program will also determine which of the various ROMs are in the PET and modify the machine code accordingly. It will work with "old", "new" of "4.0" ROMs. However, it will not work with the new 80-column PETs.

Once the subroutine has been loaded, it will give your BASIC programs significantly enhanced graphics capabilities. Specifically, you will be able to define a rectangular area on the screen and manipulate that area at machine language speed. The rectangle may be as small as a single space or as large as the entire screen. The area may be manipulated in the following ways:

Filled with any character

Reversed

Flashed on and off (i.e., fast multiple reversing)

Repositioned elsewhere on the screen

Moved (animation) in any direction at any speed with or without screen wraparound

Made to grow or shrink in size

Using The Subroutine

Your BASIC program would use the subroutine by POKEing various values into the subroutine's parameter list and then issuing a SYS(826) command. The parameter list and the corresponding POKE locations are given below:

LOCATION DESCRIPTION

- 700 Starting row (SR) (0 to 24)
- 701 Last row (LR) (0 to 24)
- 702 Starting column (SC) (0 to 39)
- 703 Last column (LC) (0 to 39)
- 704 Fill character (FC)
- 705 Row move direction (RD)
  - 0 = Up
  - 1 = Down or to side
- 706 # of rows to move (RM)
- 707 Column move direction (CD)
  - 0 = Left
  - 1 = Right or even
- 708 # of column to move (CM)
- 709 # of jiffies delay between iterations (JD)
- 710 Wraparound factor (WF)
  - 0 = Wraparound is OK
  - 1 = Disappear off screen edge
  - 2 = Move to edge only
- 711 # of iterations before returning to BASIC (IT)

The letters inside the parentheses are short-hand variable names to which I have found it useful to assign the values of the POKE locations at the beginning of the BASIC program using the subroutine. In this way I don't have to remember that Jiffy Delay is location 709, rather I can just POKE JD,6 if I want a 6 jiffy (i.e., 1/10 second) delay between iterations. Using these parameter names also reduces the chance of errors, and is faster since BASIC handles variables faster than constants. I recommend you adopt the use of these parameter variables when using this subroutine.

Listing 2 is a BASIC program that demonstrates the full range of capabilities of the graphics subroutine. You are urged to key it in, run it and then study it to see just how each of the graphic effects was obtained. You will find it very informative.

At this point it is appropriate to describe in more detail just how the parameters can be used to generate various graphic effects. NOTE: In the discussions that follow all of the parameters are assumed to be zero unless specifically stated otherwise. In fact you will find it convenient to GOSUB to a routine to zero all of the parameters before beginning any new graphics, e.g., GOSUB 7000 in Listing 2.

Defining The Rectangle

The rectangular area is defined by the values of the parameters in locations 700 to 703. The area is the intersection of the defined rows and columns. The routine assumes that the "first" row or column on the screen is number zero, not number one. If the value of the starting row (starting column) is greater than the last row (last column) the routine will assume that the rectangle "wraparound" the edge of the screen. The rectangle may be the entire screen or a single space.

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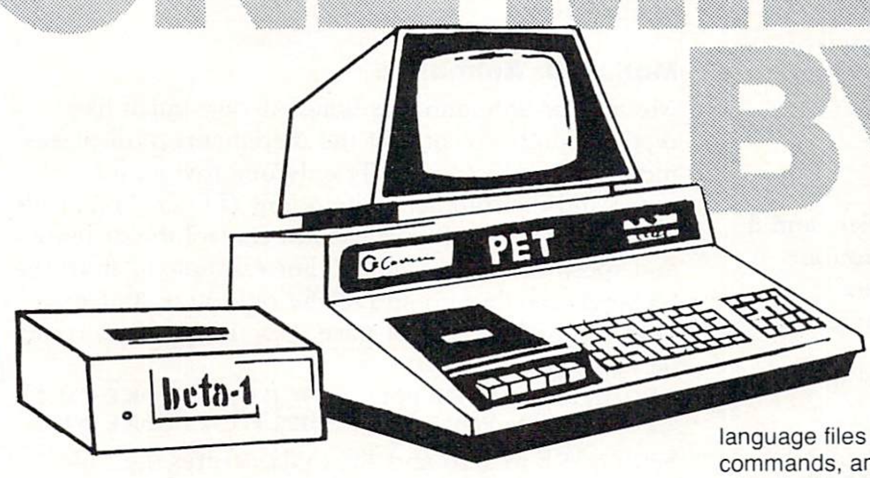

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Filling The Area

If you wish to fill the rectangular area with a character, location 704 (short-hand FC) is POKEd with the ASCII value of the desired character. For example, the following lines of code will build a border around the screen "W" wide composed of character "C":

```
1 POKE FC,C : POKE SR,0 : POKE LR,24
2 POKE SC,40-W : POKE LC,W-1 : SYS(826)
3 POKE SC,0 : POKE LC,39
4 POKE SR,25-W : POKE LR, W-1 : SYS(826)
```

Lines 1 and 2 generate the sides of the border, and 3 and 4 the top and bottom. Notice that the routine uses the wraparound (start > last) feature to generate two sides of the border with the same subroutine call.

Reversing And Flashing

When you wish to reverse the area, the Fill Character, location 704, is POKEd with zero. A special case of reversing is to flash the rectangle on and off with fast multiple reversing. This effect is obtained by POKEing location 711 (IT) with the number of times the area is to be reversed, and location 709 (JD) with the number of jiffies to delay between each reverse cycle. For example, the following code will flash the entire screen on and off by reversing it "N" times at a speed of "D" jiffies:

```
1 POKE FC,0 : POKE JD,D : POKE IT,N
2 POKE SR,0 : POKE LR,24
3 POKE SC,0 : POKE LC,39 : SYS(826)
```

Repositioning The Area

The rectangle can be repositioned in a different location on the screen by setting the parameters in locations 705 to 708. Location 705 (RD) is POKEd with a zero if the relative displacement of the new position is up and with 1 if it is down or even. Location 707 (CD) is POKEd with 0 if the displacement is left and with 1 otherwise. Locations 706 (RM) and 708 (CM) are the number of rows and columns, respectively, the area is to be displaced. For example,

```
1 POKE RD,0 : POKE RM,10
2 POKE CD,1 : POKE CM,5
```

will reposition the area five columns to the right and ten rows up.

If the "old" area is to be blanked out after the repositioning, the Fill Character (FC = 704) should have been previously POKEd with 32, i.e., an ASCII blank. If FC is zero rather than 32, then both the "old" and "new" areas will be visible on the screen after returning from the graphics subroutine.

Since this repositioning is done by relative displacement rather than absolute positioning on the screen, there will be instances when the new position will be "off the edge." Just how the routine handles these situations is determined by the value of the Wraparound Factor (WF = 710). If this value has been POKEd with a zero, the routine will automatically wraparound to the other edge(s) of the screen. If WF is 1, the portion of the rectangle that goes over the edge will not be shown. If WF is 2, the routine will automatically recalculate the reposition parameters so that the rectangle stops just at the edge of the screen.

Motion Or Animation

Motion, or animation, is handled very much like repositioning, except that the increments of displacement are smaller (typically only one row and/or column) and the number of iterations (IT = 711) and jiffies delay (JD = 709) are used to control the distance and speed of the movement. For example to show the rectangle moving up and to the right at a 30 degree angle at a relatively fast pace these instructions could be used:

```
1 POKE RD,0 : POKE RM,1 : POKE CD,1 : POKE CM,2
2 POKE IT,10 : POKE JD,2 : POKE FC,32 : POKE WF,0
```

Setting WF to zero and FC to 32 assures the "old" area is erased and that wraparound is allowed if appropriate. Even though JD was set to 2, the actual "speed" of the movement will depend on the size of the rectangle — obviously larger areas take longer to move than smaller ones — even at machine language speed! You should experiment with various values of JD to get the speed you want for your specific areas to be moved.

After returning from the subroutine, the parameters defining the rectangle will be automatically updated to correspond to the new location, so it is unnecessary to keep track of these locations in your BASIC program or to rePOKE these locations before making another move. However if you are moving several different areas "simultaneously", you should save locations 700 to 703 after exiting the routine and then rePOKE these same values before moving again (if there are intervening moves of other areas).

Listing 2 has a number of examples of movement that should be helpful to you in understanding how to use this routine effectively. The code at lines 800 to 870 should be particularly useful because it shows an easy and fast way to control motion with the numeric key pad.

Shrink And Growing

Some very interesting graphic effects are possible if you use the routine for repositioning or motion but do not POKE the Fill Character with a ASCII blank, i.e., a 32. If FC is zero, the "old" area is not changed as the "new" area is created. This allows the total graphic area to give the appearance of growing in size. Once the area has grown, FC can be set to 32 and the direction of the movement switched by 180 degrees and the area will appear to shrink. If FC is POKEd with something other than zero or 32, movement can be handled against a non-blank background, or some other characters can be left behind as the "wake" of the movement.

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Lines 880 to 980 in Listing 2 give a good example of using the routine to grow and shrink objects.

Conclusions

I hope you have as much fun using this routine as I did in writing it. If you develop any new or unusual uses for this routine drop me a note — or better yet, tape copy of the program.

If you don't want to spend the effort keying in the code in the Listings, send me $5.00 and I will send you a tape containing both the graphics loader program (Listing 1) and the demo program (Listing 2).

Listing 1

```
10 CLR:POKE59468,12
20 REM PROGRAM BY DAVID MALMBERG
30 REM 43064 VIA MORAGA
40 REM FREMONT,CALIF 94538
50 REM (415) 651-6921
60 IFPEEK(50000)=0THENPOKE134,0:
     ¬POKE135,PEEK(135)-3:GOTO80
70 POKE52,0:POKE53,PEEK(53)-3
80 CLR
90 ZZ=53:IFPEEK(50000)=0THENZZ=135
100 QQ=PEEK(ZZ)
110 PRINT"ĥ"TAB(12)"LOADING 2ND ¬
     ¬CASSETTE"
120 PRINT"h↓↓MACHINE LANGUAGE GRAPHICS"
130 PRINT"h↓↓↓↓BY DAVID MALMBERG"
140 FOR I= 826 TO 1015 :READDC:POKEI,DC:
     ¬PRINT"h";I;DC:NEXTI
150 DATA32,150,3,56,165,62,201,25,176
160 DATA61,165,63,201,25,176,55,165,68
170 DATA201,25,176,49,165,64,201,40,176
180 DATA43,165,65,201,40,176,37,165,70
190 DATA201,40,176,31,165,68,208,10,165
200 DATA70,208,6,32,0,16,56,176,3,32
210 DATA119,17,32,133,3,165,73,240,7
220 DATA198,73,240,3,76,98,3,32,168,3
230 DATA96,165,71,240,12,169,0,141,143
240 DATA0,165,71,205,143,0,208,251,96
250 DATA162,0,181,48,188,174,2,157,174
260 DATA2,148,48,232,224,32,208,241,96
270 DATA162,0,189,174,2,180,48,149,48
280 DATA152,157,174,2,232,224,32,208
290 DATA240,96,169,0,133,51,162,8,10
300 DATA38,51,6,49,144,7,24,101,48,144
310 DATA2,230,51,202,208,239,133,50,96
320 DATA169,0,133,1,133,2,165,54,240
330 DATA17,133,48,169,40,133,49,32,187
340 DATA3,165,50,133,1,165,51,133,2,24
350 DATA165,2,105,128,133,2,96
360 PRINT"h"TAB(12)"LOADING HIGH MEMORY ¬
     ¬ "
370 AA=QQ*256
380 FORI=AATOAA+626:READDC:POKEI,DC:
     ¬PRINT"h";I;DC:NEXTI
390 DATA165,62,133,54,32,213,3,166,62
400 DATA164,64,165,66,208,4,177,1,73
410 DATA128,145,1,196,65,240,10,200,56
420 DATA192,40,144,236,160,0,240,232
430 DATA228,63,240,30,232,56,224,25,176
440 DATA14,24,165,1,105,40,133,1,144
450 DATA2,230,2,56,176,206,162,0,134
460 DATA1,169,128,133,2,208,196,96,169
470 DATA0,133,60,165,67,208,87,56,165
480 DATA54,229,68,16,36,72,165,72,201
490 DATA2,208,21,24,104,101,68,133,68
500 DATA169,0,133,73,133,1,133,54,169
510 DATA128,133,2,24,144,47,201,0,208
520 DATA34,24,104,105,25,230,59,197,59
530 DATA208,16,133,54,24,165,1,105,40
540 DATA133,1,144,22,230,2,24,144,17
550 DATA133,54,32,213,3,24,144,9,169
560 DATA15,133,60,104,169,0,133,54,165
570 DATA54,133,59,96,24,165,54,101,68
580 DATA56,201,25,144,45,233,25,72,165
590 DATA72,201,2,208,31,104,133,61,230
600 DATA61,169,0,133,73,56,165,68,229
610 DATA61,133,68,169,24,133,54,169,131
620 DATA133,2,169,192,133,1,24,144,44
630 DATA201,0,208,31,104,198,59,197,59
640 DATA208,16,133,54,56,165,1,233,40
650 DATA133,1,176,22,198,2,24,144,17
660 DATA133,54,32,213,3,24,144,9,169
670 DATA15,133,60,104,169,24,133,54,165
680 DATA54,133,59,96,169,0,133,74,165
690 DATA69,208,47,56,165,76,229,70,16
700 DATA93,72,165,72,201,2,208,12,24
710 DATA104,101,70,133,70,169,0,133,73
720 DATA240,74,201,0,208,7,24,104,105
730 DATA40,24,144,63,169,15,133,74,104
740 DATA169,0,24,144,53,24,165,76,101
750 DATA70,56,201,40,144,43,233,40,72
760 DATA165,72,201,2,208,19,104,133,61
770 DATA169,0,133,73,56,165,70,229,61
780 DATA133,70,169,39,24,144,15,201
790 DATA0,208,4,104,24,144,7,169,15
800 DATA133,74,104,169,39,133,75,96
810 DATA165,67,208,11,165,62,133,55
820 DATA165,63,133,56,24,144,8,165,63
830 DATA133,55,165,62,133,56,165,69
840 DATA208,11,165,64,133,57,165,65
850 DATA133,58,24,144,8,165,65,133,57
860 DATA165,64,133,58,165,55,133,54
870 DATA32,213,3,165,1,133,52,165,2
880 DATA133,53,169,175,133,59,166,55
890 DATA134,54,134,77,32,70,16,164,57
900 DATA132,76,32,8,17,166,77,165,60
910 DATA208,14,165,74,208,10,177,52
920 DATA132,61,164,75,145,1,164,61,165
930 DATA66,240,2,145,52,196,58,240,26
940 DATA165,69,240,10,192,0,208,2,160
950 DATA40,136,24,144,207,192,39,208
960 DATA4,160,0,240,199,200,24,144,195
970 DATA228,56,240,66,165,67,240,31
980 DATA224,0,208,12,162,24,169,131
990 DATA133,53,169,192,133,52,208,162
1000 DATA202,56,165,52,233,40,133,52
1010 DATA176,152,198,53,24,144,147,224
1020 DATA24,208,12,169,128,133,53,169
1030 DATA0,133,52,162,0,240,131,232,24
1040 DATA165,52,105,40,133,52,144,227
1050 DATA230,53,24,144,222,165,62,133
1060 DATA54,32,70,16,165,59,133,62,165
1070 DATA63,133,54,32,70,16,165,59,133
1080 DATA63,165,64,133,76,32,8,17,165
1090 DATA75,133,64,165,65,133,76,32,8
1100 DATA17,165,75,133,65,96
1110 REM MODIFICATIONS FOR RELOCATION
1120 FORI=1TO3:READA:POKEQQ*256+A,QQ:
     ¬NEXTI
1130 DATA448,588,599
1140 FORI=1TO3:READA:POKEQQ*256+A,QQ+1:
     ¬NEXTI
1150 DATA455,610,621
1160 POKE876,QQ
1170 POKE882,QQ+1
1180 REM MODIFICTIONS FOR OLD ROMS
```

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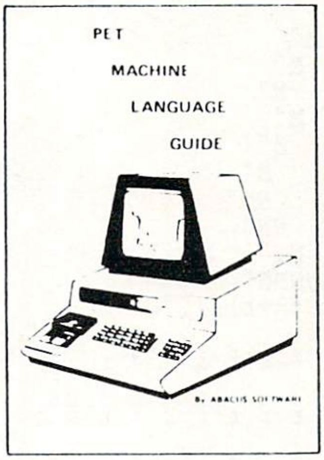
```
1190 IFPEEK(50000)<>0THEN1220
1200 FORI=1TO4:READA:POKEA,2:NEXTI
1210 DATA908,909,913,914
1220 PRINT"ĥr̲LOCATIONr̂      r̲DESCRIPTIONr̂"
1230 PRINT"   700        STARTING ROW"
1240 PRINT"   701        LAST ROW"
1250 PRINT"   702        STARTING COLUMN"
1260 PRINT"   703        LAST COLUMN"
1270 PRINT"   704        FILL CHARACTER"
1280 PRINT"   705        ROW MOVE DIRECTION
     ¬"
1290 PRINT"                0=UP"
1300 PRINT"                1=DOWN OR TO ¬
     ¬SIDE"
1310 PRINT"   706        # OF ROWS TO MOVE"
1320 PRINT"   707        COLUMN MOVE ¬
     ¬DIRECTION"
1330 PRINT"                0=LEFT"
1340 PRINT"                1=RIGHT OR EVEN"
1350 PRINT"   708        # OF COLUMNS TO ¬
     ¬MOVE"
1360 PRINT"   709        # OF JIFFIES ¬
     ¬DELAY BETWEEN"
1370 PRINT"                ITERATIONS"
1380 PRINT"   710        WRAPAROUND FACTOR"
1390 PRINT"                0=WRAPAROUND IS ¬
     ¬OK"
1400 PRINT"                1=DISAPPEAR OFF ¬
     ¬EDGE"
1410 PRINT"                2=MOVE TO EDGE ¬
     ¬ONLY"
1420 PRINT"   711        # OF ITERATIONS ¬
     ¬BEFORE EXIT"
1430 PRINT"   826        SYS LOCATION FOR ¬
     ¬ROUTINES"
1440 END
```

Listing 2

```
0 :CLR:POKE59468,12
1 REM MACHINE LANGUAGE GRAPHICS DEMO
2 REM PROGRAM BY DAVID MALMBERG
3 REM 43064 VIA MORAGA
4 REM FREMONT, CALIF 94538
5 REM (415) 651-6921
100 QQ=53:KY=151:IFPEEK(50000)=0THENQQ=1
     ¬35:KY=547
110 AA=PEEK(QQ)*256
120 IFPEEK(826)<>32ORPEEK(AA)<>165THENPR
     ¬INT"ĥMACHINE LANGUAGE NOT LOADED":
     ¬END
130 SR=700:LR=701:SC=702:LC=703:FC=704:
     ¬RD=705:RM=706:CD=707:CM=708
140 JD=709:WF=710:IT=711:SY=826
150 R$="h̲↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓↓":
     ¬C$="→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→
     ¬→"
160 X=RND(-TI):DIMX%(8),A(8),B(8)
170 DEF FNR(N)=INT(N*RND(1))
180 FORI=0TO8:READX%(I):NEXTI
190 DATA209,214,215,223,102,42,127,218,
     ¬219
200 A$=LEFT$(C$,11):B$=LEFT$(C$,5)
210 PRINT"ĥ"LEFT$(R$,6):GOSUB6000
215 REM BUILD BORDERS
220 GOSUB7000:W=4
230 FORI=0TO8:C=X%(I):GOSUB7100:Q=TI
235 IFTI-Q<60THEN235
236 NEXTI
240 C=32:GOSUB7100
250 REM FLASH SCREEN
260 POKEFC,0:N=30:D=15:GOSUB7300
270 REM MAKE REVERSE SQUARES
280 C=0:FORW=1TO4:GOSUB7200:Q=TI
290 IFTI-Q<30THEN290
300 NEXTW
310 W=4:C=32:GOSUB7100
320 C=0:GOSUB7100
330 N=1:D=30:GOSUB7300
340 N=1:D=30:GOSUB7300
350 W=4:C=32:GOSUB7100
360 REM MOVE LEFT:GOSUB7000
370 POKERS,6:POKELR,19:POKESC,5:
     ¬POKELC,35:POKERD,0:POKERM,0
380 POKERM,0:POKECD,1:POKECM,1:POKEIT,
     ¬40:SYS(SY)
390 REM MOVE DOWN
400 POKERD,1:POKERM,1:POKECD,0:POKECM,0:
     ¬POKEIT,25:SYS(SY)
410 REM MOVE UP & OFF
420 POKERD,0:POKECD,1:POKECM,1:POKEWF,1:
     ¬POKEIT,20:SYS(SY)
425 PRINT"ĥ":PRINT
430 REM SHIP & R2D2
440 PRINT"h̲":A$=LEFT$(C$,11):GOSUB5000
450 A$=LEFT$(C$,1):PRINTLEFT$(R$,14):
     ¬GOSUB5200
460 A(0)=0:A(1)=9:A(2)=11:A(3)=39
470 A(5)=1:A(6)=0:A(7)=0:A(8)=1:A(4)=32
475 GOSUB7000:A$=LEFT$(R$,15)+LEFT$(C$,
     ¬9)
480 POKESR,13:POKELR,24:POKESC,0:
     ¬POKELC,13:POKEFC,32:POKERD,1:
     ¬POKERM,0
490 POKECD,1:POKECM,1:DL%=6
495 FORK=1TO2
505 DL%=0.5*DL%:POKEJD,DL%:POKEIT,40
510 FORJ=0TO8:B(J)=PEEK(700+J):POKE700+J
     ¬,A(J):NEXTJ:SYS(SY)
540 PRINTA$"...BEEP BEEP":Q=TI
550 IFTI-Q<60THEN550
552 PRINTA$"               "
553 DL%=1.5*DL%:POKEJD,DL%:POKEIT,40
555 FORJ=0TO8:A(J)=PEEK(700+J):POKE700+J
     ¬,B(J):NEXTJ:SYS(SY)
560 PRINTA$"...SQEEEEEEK":Q=TI
570 IFTI-Q<60THEN570
580 PRINTA$"               "
590 NEXTK
600 POKEJD,0:POKERD,0:POKERM,13:
     ¬POKECM,0:POKECM,0:POKEWF,1:SYS(SY)
610 A$=LEFT$(R$,2)+LEFT$(C$,9)
620 PRINTA$"...BEEP BEEP":Q=TI
630 IFTI-Q<60THEN630
640 PRINTA$"               "
650 POKERM,0:POKECD,1:POKECM,1:POKEIT,
     ¬40:SYS(SY)
700 REM SPACE SHIP
710 GOSUB7000:PRINT"ĥ"LEFT$(R$,19):
     ¬A$=LEFT$(C$,18):GOSUB5100
720 PRINT"h̲↓↓→→USE NUMERIC KEYS TO ¬
     ¬CONTROL DIRECTION"
730 PRINT"↓→→→→→→PUSH r̲0r̂ WHEN YOU WISH ¬
     ¬TO QUIT"
740 POKESR,1:POKELR,5:POKESC,1:POKELC,
     ¬39:POKEFC,0:POKEIT,9:POKEJD,20:
     ¬SYS(SY)
750 Q=TI
760 IFTI-Q<180THEN760
770 POKEFC,32:SYS(SY)
780 POKESR,19:POKELR,24:POKESC,18:
```

```
      ¬POKELC,22:POKEJD,Ø:POKERD,Ø:
      ¬POKERM,1
790 POKECD,1:POKECM,Ø:L=255
795 REM MOVEMENT USING MATRIX VALUE OF ¬
      ¬KEY BEING PRESSED
800 K=PEEK(KY):IFK=255ORK=34THEN800
805 IFK=LTHEN860
810 IFK=1ØTHEN870
820 IFK>49THENPOKERD,Ø:POKERM,1:GOTO840
830 POKERD,1:POKERM,Ø:IFK<3ØTHENPOKERM,1
840 POKECM,1:POKECD,1:IFK=58ORK=42ORK=26
      ¬THENPOKECD,Ø
850 IFK=5ØORK=18THENPOKECM,Ø
860 SYS(SY):L=K:GOTO800
870 FORI=1TO1Ø:GETZ$:NEXTI:REM EMPTY ¬
      ¬KYBD BUFFER
880 REM ARROW GROWS
890 GOSUB7ØØØ:POKESR,1Ø:POKELR,17:
      ¬POKESC,9:POKELR,17:POKEIT,7:
      ¬POKEJD,5
900 POKERM,1:POKECM,1
910 PRINT"ĥ":GOSUB62ØØ
920 FORK=1TO5:POKEJD,5-K:Q=TI
925 IFTI-Q<12ØTHEN925
930 POKEFC,Ø:POKERD,1:POKECD,1:SYS(SY):
      ¬Q=TI:REM GROW
935 IFTI-Q<6ØTHEN935
940 POKEFC,32:POKEIT,1Ø:POKERD,Ø:
      ¬POKECD,Ø:SYS(SY):REM SHRINK
950 POKEIT,1Ø:NEXTK
960 Q=TI:REM SHOOT OFF SCREEN
965 IFTI-Q<12ØTHEN965
970 POKESR,Ø:POKESC,Ø:POKERD,1:POKECD,1
980 POKEJD,Ø:POKEWF,1:POKEIT,26:SYS(SY)
1000 REM REVERSE DESIGN
1010 GOSUB7ØØØ:POKEJD,1Ø
1020 PRINT"ĥ":Q=1:K=Ø:GOTO1Ø4Ø
1030 Q=FNR(4)+1:K=FNR(23)
1040 FORI=KTO24STEPQ
1050 POKESR,I:POKELR,24-I:POKESC,I:
      ¬POKELC,39-I:SYS(SY):NEXTI
1060 IFRND(1)>.9THEN1Ø2Ø
1070 GETZ$:IFZ$=""THEN1Ø3Ø
1075 REM SUPER GRAPHICS
1090 A$=LEFT$(C$,11):B$=LEFT$(C$,5)
1100 PRINT"ĥ"LEFT$(R$,6):GOSUB6ØØØ
1110 GOSUB7ØØØ:POKEJD,2Ø
1120 C=Ø:FORW=1TO4:GOSUB72ØØ:Q=TI
1130 IFTI-Q<3ØTHEN113Ø
1140 NEXTW
1145 FORI=1TO1Ø:GETZ$:NEXTI:REM EMPTY ¬
      ¬KYBD BUFFER
1150 END
5000 PRINTA$"                  ' "
5010 PRINTA$"            1     'L"
5020 PRINTA$"            1     ' "
5030 PRINTA$"            1     '%"
5040 PRINTA$"          ,r<r̂1      '%"
5050 PRINTA$"            r r̂3 *r r̂   '%"
5060 PRINTA$"       $$$r> r̂= 6r r̂    ¬
      ¬r>r̂M$$$$
5070 PRINTA$"    @@""r ..r̂  r  <r̂  r. ¬
      ¬..r̂""@@
5080 PRINTA$" ^r ....      .. ..    ..... ¬
      ¬ ,"
5090 PRINTA$"  ^r                         ¬
      ¬,
5095 RETURN
5100 PRINTA$" '> "
5110 PRINTA$" r) ^r̂ "
```


PET' MACHINE LANGUAGE GUIDE



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```
5120 PRINTA$" r > f "
5130 PRINTA$"r)USA^f"
5140 PRINTA$"Nr)"^fM"
5150 RETURN
5200 PRINTA$">r)O;f)M"
5210 PRINTA$">r ?f)  M"
5220 PRINTA$">r<f)    M"
5230 PRINTA$">)  UI  M"
5240 PRINTA$">M  ||   M"
5250 PRINTA$">>M ||    M"
5260 PRINTA$">>>M||     N%"
5270 PRINTA$">>>>||     NN"
5280 PRINTA$">>>>||   NV"
5290 PRINTA$">>>>||MNNMM"
5300 PRINTA$">>>r)((^f>>r)((^"
5310 RETURN
6000 PRINTA$"r) ^f r f r f r  ^f r    f ¬
   ¬r  ^f"
6010 PRINTA$"r f r f r f r f r f r f r ¬
   ¬f     r f r f"
6020 PRINTA$"^r^f   r f r f r  f) r  f  ¬
   ¬r  f)"
6030 PRINTA$" ^r^f r f r f r f    r f   ¬
   ¬r ^f"
6040 PRINTA$"r f r f r f r f r f    r f  ¬
   ¬ r f^r^f"
6050 PRINTA$"^r f) ^r f) r f    r    f r ¬
   ¬f r f"
6060 PRINT
6082 PRINTB$"r) ^f r  ^f r) ^f r  ^f";
6084 PRINT" r f r f r    f r) ^f r) ^f"
6092 PRINTB$"r f r f r f r f r f r f";
6094 PRINT" r f r f r f r f   r f  r f r ¬
   ¬f r f r f"
6102 PRINTB$"r f    r  f) r f r f";
6104 PRINT" r  f) r    f  r f  r f    ¬
   ¬^r^f"
6112 PRINTB$"r ! f r ^f  r    f r f";
6114 PRINT"   r f r f  r f  r f     ^r^f"
6122 PRINTB$"r f r f r f^r^f r f r f";
6124 PRINT" r f   r f r f  r f  r f r f ¬
   ¬r f r f"
6132 PRINTB$"^r   f r f r f r f r f r f";
6134 PRINT"   r f r f r    f ^r f) ^r f)"
6140 RETURN
6200 PRINT"    !\"
6210 PRINT"    ''\"
6220 PRINT"    '''\"
6230 PRINT"$$$NM%%%"
6240 PRINT"\$$M M%%"
6250 PRINT" \$#M M%"
6260 PRINT"  \##M M"
6270 PRINT"   ###M M"
6280 PRINT"         M M"
6290 PRINT"          M M"
6300 PRINT"           M M"
6310 PRINT"            M M  r^f"
6320 PRINT"             M M r ^f"
6330 PRINT"              M Mr  ^r"
6340 PRINT"               Mr)    f"
6350 PRINT"            ^r        f"
6360 PRINT"             ^r       f"
6370 PRINT"              ^r      f"
6380 RETURN
7000 REM SUB TO ZERO PARAMETERS
7010 FORM=0TO11:POKE700+M,0:NEXTM:RETURN
7100 REM SUB TO BUILD A BORDER W WIDE ¬
   ¬WITH CHARACTER C
7110 POKEFC,C:POKESR,0:POKELR,24
7120 POKESC,40-W:POKELC,W-1:SYS(SY)
7130 POKESC,0:POKELC,39
7140 POKESR,25-W:POKELR,W-1:SYS(SY):
   ¬RETURN
7200 REM SUB TO FILL AN AREA WITHIN A ¬
   ¬BORDER W WIDE WITH CHARACTER C
7210 REM IF C=0 THEN REVERSE AREA ..IF ¬
   ¬C=32 THEN BLANK AREA
7220 POKEFC,C:POKESR,W:POKELR,24-W
7230 POKESC,W:POKELC,39-W:SYS(SY):RETURN
7300 REM SUB TO REVERSE SCREEN N TIMES ¬
   ¬WITH D JIFFY DELAY BETWEEN ¬
   ¬ITERATIONS
7310 POKEJD,D:POKEIT,N:POKESR,0:
   ¬POKELR,24
7320 POKESC,0:POKELC,39:SYS(SY):RETURN
```

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Disk File Recovery Program

David L. Cone, Sunnyvale, CA

Have you ever been working happily along on a program, updating it periodically on your disk, only suddenly to discover that something wierd has happened and you've apparently lost half of the programs on the disk. (I've even had the case where the programs disappeared from the directory while the number of blocks remaining stayed the same). Maybe what happened was that AFTER you scratched the program from the disk you found that the PET had also gobbled up your program in memory — (or you did). Or perhaps you had done a short 'new' of a disk only then to realize that valued programs were on it!

If you've ever been in this frustrating position of knowing your program was just sitting there on the disk with no easy way to get it back, this DISK FILE RECOVERY program will help — it will recover such programs. As long as you can still initiate the disk and have not written a new program over the file you want, you can recover it. It cannot recover programs from a disk which will not initiate or upon which a long 'new' (ie. a 'new' with a disk number) has been performed.

The disk works this way: When a file is placed on a disk, part of the information placed in the directory on track 18 is a pair of pointers giving the track and sector numbers of the block where the file begins. The first two bytes of this block are also pointers giving the next track and sector numbers. This process continues until the last block is reached. For the last block, a 00 is placed in the first byte and nothing appears to be done to the second. Files are stored in a somewhat alternating way below and above track 18. The first file is stored starting at 17,0 (track 17, sector 0). When track 17 is filled, the next new file appears to be started at 19,0 and so on back and forth. If you have lost or destroyed track 18, the problem is then how to find and identify the initial blocks of the lost files and then to recover the files.

This is what the RECOVERY program does! First, it gives you the choice of working with either the lower band (tracks 17 to 1) or upper band (tracks 19 to 35), and on which track you wish to stop. It sets up an integer array [D%(35,20,3)] which can receive for each block the "in" pointers (ie. the track and sector numbers of the block which 'points' at it) and the "out" pointers (ie. the track and sector number of the block at which it points. The program then scans the first track for these pointers. What we are looking for are blocks which have no "in" pointers, for they must be the ones pointed at by the directory and thus the initial blocks for any files. Next the program takes each initial block and follows that file through all its blocks to the end, filling in the array as it goes. Each subsequent track is similarly scanned and as new files are found they are traced. You have the option of stopping this process at any point. Meantime, the program has kept track of the start and end of each file and the number of blocks it uses. This summary is presented on the screen.

The next major problem is the identifying which file is which (since only the disk knows where a file was saved and on which half of the disk). The program offers you a number of appropriate options at this point, and the most useful one for file identification is labeled LOOK. LOOK pulls the initial block of any file out and extracts information that will probably allow you to identify the file. First, it displays in a useful form the first four pairs of bytes. The first pair are the pointers to the next block. If the file is a program the next pair of bytes tell where the program is to be loaded in memory. For Basic programs, this is usually 1024. The third and fourth pairs of bytes are from the program itself. They are the link and line number of the first instruction in the basic program. If the file is a machine language program or a sequential file, then you get weird and meaningless values for the link and line numbers. Next, LOOK gives you the first 48 bytes of the program in hexadecimal form (as if they were being examined by the machine language monitor). Finally, LOOK gives you a printed "translation" of the first 240 bytes. Basic commands are tokenized and appear as reversed characters or symbols. The link and line pointers also can look quite strange. However, numbers, variables, anything between quotes, and REM statements all appear as usual. Thus, if you have some convenient identifications at the beginning of your program, you will be able to recognize them. To see how this "translation" takes place, see lines 1360-1390 and 5090-5095. Eighty characters are scanned at one time and you can go from one set of eighty to another. With this amount of information it is usually quite easy to determine what any file is and if you wish to recover it.

Aside from LOOK, you have the following options: 1) SUMMARY REVIEW — this gives you the start block of any file and the number of blocks in that file. You need to know the start block to either look at or recover a file. Also, the number of blocks in the file may aid in its identification. 2) RETRIEVE A FILE — here is the point of all of this; now you get the program or file back! The program asks for all the essential things: starting track and sector, the name you want for the recovered file

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and whether it is a program or a data file. It gives one final chance to abort unless everything is ok and then it is off and running. 3) SCAN OTHER BAND, 4) DIFFERENT DISK, and 5) EXIT PROGRAM are all obvious.

The program itself, while complex in details, is straightforward in construction. It is divided into the following sections:

400- 492 Program description and credits
500- 595 Description of all variables
600- 696 Start of Program — Initial choices
700- 865 Search for initiator blocks
1000-1055 Print summary table
1100-1165 Choices
1200-1415 Performs LOOK option
1500-1655 Retrieves the file
4000-4076 General subroutines
5000-5109 Disk operation subroutines

"REM**" statements are used to show major divisions of the program while "REM @" indicates descriptive statements within these major divisions. I have used REM statements fairly liberally and these should help in tracing through the details of the program. A pair of REM statements (line numbers 1410 and 4003) need a special comment: if you have a machine language screen dump capability, you should SYS to them here. I use a shifted "P" to activate the screen dump.

A couple of final comments: If you search tracks in which there are no programs, you may get a disk read error (22 READ ERROR 13,0). If this occurs, simply type GOTO 1000 and you will be able to go on without any problems. I hope this program is as useful to you as it has been to me. I made it because I really needed it. You may not need it often, but when you do, the situation is likely to be desperate!

```
GOTO5    TRACK   19 SUMMARY TABLE
SEC ▌ TR   IN    SC   |    TR  OUT   SC
 0  ▌ 0          0    |    19        10
 1  ▌ 19         10   |    19        11
 2  ▌ 19         11   |    19        12
 3  ▌ 19         12   |    19        13
 4  ▌ 19         13   |    19        14
 5  ▌ 19         14   |    19        15
 6  ▌ 19         15   |    64        220
 7  ▌ 0          0    |    19        17
 8  ▌ 19         17   |    19        18
 9  ▌ 19         18   |    64        214
 10 ▌ 19         0    |    19        1
 11 ▌ 19         1    |    19        2
 12 ▌ 19         2    |    19        3
 13 ▌ 19         3    |    19        4
 14 ▌ 19         4    |    19        5
 15 ▌ 19         5    |    19        6
 16 ▌ 0          0    |    64        130
 17 ▌ 19         7    |    19        8
 18 ▌ 19         8    |    19        9
 19 ▌ 0          0    |    20        8
        TYPE ANY KEY TO CONTINUE
```

Figure 1. Track 19 Summary Table
A summary table such as this is made for each track scanned. The zeros in the IN column indicate the initial block of a file. The 64 in the OUT column shows where a file ends.

```
GOTO5

          RECOVERED DISK SEQUENCES

                 SEQUENCE 1

                             TRACK      SECTOR

START                         17          0

PRESENT BLOCK   11            17          12

END                           17          12

NUMBER OF BLOCKS              11


  <C-CONT   P-PAUSE   H-HALT   S-SUMMARY>
         TYPE ANY KEY TO CONTINUE
```

Figure 2. Recovered Disk Sequence
As each file is traced, this table keeps track of what is happening and summarizes the results.

```
GOTO5         FIRST PAGE DATA

                           TRACK      SECTOR
INITIAL BLOCK               17          0
                 BYTES
BLOCK POINTER     0&1       17          10
                           DECIMAL VALUE
PRGRM START       2&3        1025
1ST LINK          4&5        1032
1ST LINE #        6&7          0
HEX VALUES
  00  :    11 0A 01 04 08 04 00 00
  08  :    89 35 00 21 04 01 00 99
  10  :    22 93 11 11 11 3E 49 31
  18  :    9D 9D 9D 11 3E 24 31 13
  20  :    22 3A 80 00 3D 04 02 00
  28  :    99 22 93 3E 53 30 3A 43

CHARACTER VALUES:

QJADHD@@◤5@!DA@▬"┤QQQ>I1┘┘┘Q>$1S": @=DB@
▬"┤>S0:COPY DISK+":▬">"@$DC@▬"QS♠"|(34)"

 'C' TO CONTINUE: +/- CHANGE LINE SCAN
```

Figure 3. First Page Data Program File
A typical BASIC program looks this way. Note the following: PRGRM START = 1025; typical 1st LINK and LINE # values; and identifiable features in the CHARACTER VALUES. (Unfortunately, my dump program does not give reversed characters which would assist in identifying BASIC tokens).

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```
GOTO5          FIRST PAGE DATA

                         TRACK       SECTOR
INITIAL BLOCK              20           0
                    BYTES
BLOCK POINTER        0&1   20          10
                         DECIMAL VALUE
PRGRM START          2&3      28672
1ST LINK             4&5       1954
1ST LINE #           6&7       9149
HEX VALUES
   00 :   14 0A 00 70 A2 07 BD 23
   08 :   70 95 78 CA D0 F8 A2 0A
   10 :   8E E2 03 A2 00 8E E3 03
   18 :   86 83 86 7C 86 81 CA 86
   20 :   BC A2 64 86 82 86 80 60
   28 :   4C D0 72 00 4C F8 72 20

CHARACTER VALUES:

TJ@0▄G┘#0▌8 ╲┳▄J┐▄C▄@┐▔C▒▔▒C▒▌ ▒▝▄$▒▄▒
L▔2@L▔2 0@r. ┌J 3 IH _2Q▄ _2Q ( r[╮, rCLC/ 0

 'C' TO CONTINUE: +/- CHANGE LINE SCAN
```

Figure 4. First Page Data Machine Language Program

This program was put into high memory starting at 28672. Note the rather random CHARACTER VALUES, and FIRST LINK and LINE values.

```
GOTO5          FIRST PAGE DATA

                         TRACK       SECTOR
INITIAL BLOCK              17           1
                    BYTES
BLOCK POINTER        0&1   17          11
                         DECIMAL VALUE
PRGRM START          2&3      21062
1ST LINK             4&5      20805
1ST LINE #           6&7      17749
HEX VALUES
   00 :   11 0B 46 52 45 51 55 45
   08 :   4E 43 59 20 42 59 20 52
   10 :   52 0D 20 37 30 20 0D 20
   18 :   38 20 0D 20 38 20 0D 46
   20 :   52 45 51 0D 20 37 20 0D
   28 :   52 52 0D 20 32 20 0D 53

CHARACTER VALUES:

QKFREQUENCY BY RRM 70 M 8 M 8 MFREQM 7 M
RRM 2 MSVCEM 5 MCMNTSM 24 MUSAGEM 1 MSIG

 'C' TO CONTINUE: +/- CHANGE LINE SCAN
```

Figure 5. First Page Data Sequential Data File

The easiest way to identify this type of file is to observe the data items separated by "M" in the CHARACTER VALUES section. The "M" is the screen representation of CHR$(13) and is in reverse field on the screen.

```
GOTO5
              FILE SUMMARY

SEQ #        BLOCKS        START        FINISH
                          TR   SEC     TR   SEC
  1            11         17    0      17   12
  2            13         17    1      16    5
  3             3         16    0      16   20
  4             7         16    1      16    4
  5            40         16    6      14   20
  6             1         14    2      14    2
  7             2         14   12      14    4
  8             8         14   14      13    7

          TYPE ANY KEY TO CONTINUE
```

Figure 6. File Summary

This table summarizes the completed scan results. The START track and sector numbers are needed to use the LOOK and RETRIEVE options.

```
         RECOVERED DISK SEQUENCES

             SEQUENCE 8

                        TRACK       SECTOR

START                    14           14

PRESENT BLOCK   8        13            7

END                      13            7

NUMBER OF BLOCKS         8


 (C-CONT   P-PAUSE   H-HALT   S-SUMMARY)


DISK ERROR AT PROGRAM LINE  5021

ERROR MESSAGE: 22  READ ERROR  13 , 0

READY.
```

Figure 7. Recovered Disk Sequence

This is what you may see if you try to recover files from a part of the disk where no files have been written. Simply type GOTO 1000 to continue.

```
0 GOTO400
5 PRINT"RUN":LIST500-525
10 INPUT"SAVE ON DRIVE #";A:A$="DISK ¬
      ¬FILE RCVRY":IFA<>0ANDA<>1GOTO10
11 B$=STR$(A)+":"+A$:OPEN15,8,15,"S"+B$:
      ¬CLOSE15:PRINTA$" SCRATCHED
12 SAVEB$,8:VERIFYB$,8:PRINTA$" SAVED ¬
      ¬AND VERIFIED":END
400 REM ******************************
401 REM *
402 REM *    DISK FILE RETRIEVER
403 REM *
404 REM *      BY  DAVID CONE
405 REM *
425 REM ******************************
427 REM * PUT DISK WITH LOST FILES
```

```
429 REM * INTO DRIVE 1.  THIS PROGRAM
431 REM * WILL THEN SEARCH FOR FILES
433 REM * IN TRACKS 17-1 & 19-35 AND
435 REM * RETURN THE START BLOCK, END
437 REM * BLOCK, AND NUMBER OF BLOCKS.
439 REM * THE FIRST 256 BYTES OF ANY
441 REM * FILE MAY BE EXAMINED TO
443 REM * ALLOW IDENTIFACATION.
445 REM * ANY IDENTIFIED FILE CAN BE
447 REM * COPIED ONTO DRIVE Ø.
45Ø REM *****************************
452 REM * USAGE: DRIVES:
454 REM *     DRIVE Ø:  GOOD DISK
456 REM *     DRIVE 1:  DAMAGED DISK
458 REM *  LOGICAL FILES:
47Ø REM *     1: WRITE FROM KEYBOARD
472 REM *     8: READ FROM DISK
474 REM *     9: WRITE TO DISK
476 REM *    15: DISK CONTROL
478 REM *  DISK CHANNEL: 2
48Ø REM *  DISK BUFFER: #2 (19ØØ-19FF)
482 REM *****************************
484 REM *  PROGRAM ENTRY POINTS
486 REM *      1Ø - SAVE & VERIFY PRGM
488 REM *    1ØØØ - PRINT SUMMARY TABLE
49Ø REM *    11ØØ - CHOICES
492 REM *****************************
5ØØ REM ** NUMERICAL VARIABLES
5Ø1 P(Ø)=Ø:REM PRESENT TRACK #
5Ø2 P(1)=Ø:REM PRESENT SECTOR #
5Ø3 L(Ø)=Ø:REM TRACK LINK
5Ø4 L(1)=Ø:REM SECTOR LINK
5Ø5 SR=17: REM START TRACK (17 OR 19)
5Ø6 SP=ØØ: REM END TRACK
5Ø7 SM=2Ø: REM MAX # OF SCTRS IN TRACK
5Ø8 TR=SR: REM VARIABLE TRACK VALUE
5Ø9 :M=Ø1: REM SEQUENCE #
51Ø MM=5Ø: REM MAX # OF SEQUENCES
511 :N=ØØ: REM # OF BLOCKS IN SEQ
512 PS=ØØ: REM START OF BASIC
513 PL=ØØ: REM 1ST LINK POINTER
514 PN=ØØ: REM 1ST LINE #
515 ES=ØØ: REM ERROR IN SECTOR
516 ET=ØØ: REM ERROR IN TRACK
517 EL=ØØ: REM DISK ERROR IN LINE #
524 :    : REM  A,J,K GENERAL VARBLS
53Ø REM **
531 REM ** STRING VARIABLES
532 :      :REM A$,Z$ GENERAL VARIABLES
533 B$="" :REM  CONT RUN VARIABLE
534 F$="" :REM  NEW FILE NAME
535 T$="" :REM  TYPE OF FILE CREATED
536 EN$="ØØ" :REM  DISK ERROR #
537 EM$=" OK":REM  DISK ERROR MESSAGE
538 S$="   ←←←" :REM  STRING UTILITY
539 H$="Ø123456789ABCDEF":REM HEX DGTS
54Ø ZG$="ĥGOTO5":REM  STRING UTILITY
575 REM **
576 REM ** MATRIX VARIABLES
577 DIMD%(35,2Ø,3):REM  BLOCK POINTERS
578 : REM  ^  ^ Ø,1 IN TRK & BLK PNTRS
579 : REM  ^  ^ 2,3OUT TRK & BLK PNTRS
58Ø : REM  ^  2Ø-BLOCK NUMBER
581 : REM 35- - -TRACK NUMBER
582 DIMS%(MM,4):REM  SEQUENCE DATA
583 : REM    Ø,1  START TRACK & BLOCK
584 : REM    2    NUMBER OF BLOCKS
585 : REM    3,4  END    TRACK & BLOCK
```


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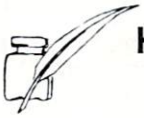

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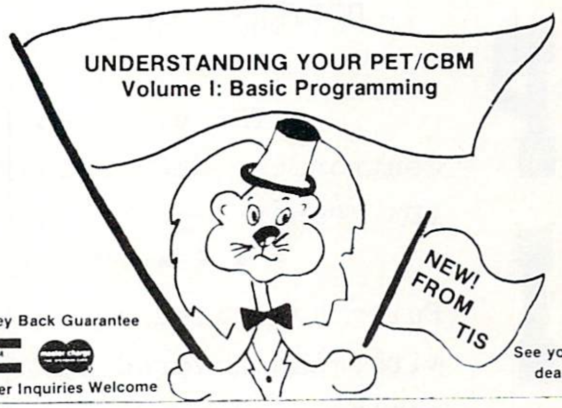

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```
590 REM **
595 OPEN15,8,15:EL=595:GOSUB5100
600 REM ** PAGE 1/INTRODUCTION,TRACKS
605 OPEN1,0:PRINTZG$:PRINTTAB(9)"↓↓rDISK
     ¬ RECOVERY PROGRAM
610 PRINT"↓↓   PUT DISK FOR RECOVERY IN ¬
     ¬ rDRIVEf̂ rl
615 PRINT"↓↓↓   HIT ANY KEY WHEN rDISKf̂ ¬
     ¬IS IN PLACE.
620 PRINT"↓   (DISK WILL THEN BE ¬
     ¬INITIALIZED)":GOSUB4000
625 PRINT#15,"I1":EL=625:GOSUB5100
630 PRINT"↓↓ START: TRACK r17f̂ (DOWN) ¬
     ¬OR r19f̂ (UP)? r17f̂←←r";:INPUT#1,
     ¬SR:PRINT
635 IFSR<>17ANDSR<>19THENPRINT"↑↑↑↑":
     ¬GOTO630
640 PRINTTAB(7)"↓END SEARCH AT TRACK:
     ¬       ←←←←r";:INPUT#1,SP:PRINT
645 IFSR=17THENIFSP<1ORSP>16THENPRINT"↑↑
     ¬↑":GOTO640
650 IFSR=19THENIFSP<20ORSP>35THENPRINT"↑
     ¬↑↑":GOTO640
655 CLOSE1:FORJ=0TO1000:NEXT
660 REM ** PAGE 2/DESCRIPTION
662 POKE59468,14:PRINTZG$:PRINT"↓TRACKS"
     ¬SR"TO"SP"WILL NOW BE SEARCHED FOR
664 PRINT"h↓↓↓FILES.  THE INITIAL AND ¬
     ¬ENDING BLOCKS
666 PRINT"AND THE LENGTH OF EACH ¬
     ¬RECOVERED FILE
668 PRINT"ARE RECORDED.  (TRACK ¬
     ¬SUMMARIES ARE
670 PRINT"ALSO DISPLAYED).
```

```
672 PRINT"↓THIS SEARCH CAN RUN CONTINUOU
     ¬SLY, BE
674 PRINT"HALTED AFTER EACH OPERATION,
     ¬ HAVE A
676 PRINT"PAUSE AFTER EACH OPERATION,
     ¬ OR BE ENDED
678 PRINT"WITH A JUMP TO THE SUMMARY.
680 PRINT"↓↓      TYPE rCf̂ FOR CONTINUOUS
     ¬ RUNNING
682 PRINT"      TYPE rHf̂ FOR HALT IN ¬
     ¬OPERATION
684 PRINT"      TYPE rPf̂ FOR PAUSES IN ¬
     ¬OPERATION
686 PRINT"      TYPE rSf̂ TO ESCAPE TO ¬
     ¬SUMMARY
688 PRINT"↓↓OPERATIONAL MODE MAY BE ¬
     ¬CHANGED DURING
690 PRINT"THE SEARCH BY TYPING THE ¬
     ¬ABOVE COMMANDS AT ANY TIME.
692 GOSUB4000:B$=A$
694 PRINTZG$:POKE59468,12:TR=SR:M=1
696 OPEN8,8,2,"#2":EL=695:GOSUB5100
700 REM ** FIND INITIATOR BLOCKS
705 P(0)=TR:GOSUB5010:REM @ GET NUMBER ¬
     ¬OF BLOCKS IN TRACK TR
710 FORK=0TOSM:P(1)=K:REM @ SEARCH TRK
715 :IFD%(P(0),P(1),2)<>0GOTO735
720 :GOSUB5020:REM @ GET LNKS/OUT PTRS
725 :IFL(0)=0THEND%(P(0),P(1),2)=64:
     ¬GOTO735 :REM @ END OF FILE FOUND
730 :GOSUB5040:REM @ IN PTRS TO NXT BLK
735 NEXT
740 GOSUB4060:REM @ TRK TABLE
745 REM ** FOLLOW LINKS FOR EACH START
```


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```
750 P(Ø)=TR
755 FORK=ØTOSM:P(1)=K:N=1
760 :IFD%(P(Ø),P(1),Ø)<>ØGOTO835
765 :S%(M,Ø)=P(Ø):S%(M,1)=P(1)
770 :GOSUB4Ø1Ø:REM @ PRINT DISPLAY
775 :PRINT"↑"TAB(14)S$N,S$P(Ø),S$P(1)
780 :GOSUB5Ø2Ø:REM @ GET LINKS
785 :IFL(Ø)=ØTHEND%(P(Ø),P(1),2)=64:
     ¬GOTO8Ø5
790 :GOSUB5Ø4Ø:REM @ IN PTRS TO LNK BLK
795 :P(Ø)=L(Ø):P(1)=L(1):N=N+1
800 :GOTO775
805 :REM @ CLOSE END OF LNK SEQUENCE
810 :S%(M,2)=N:S%(M,3)=P(Ø)
815 :S%(M,4)=P(1)
820 :GOSUB4Ø2Ø:REM @ COMPLETE DISPLAY
825 :IFB$="S"THENK=SM
830 :M=M+1:P(Ø)=TR:REM @ RESETS
835 NEXT
840 IFB$="S"GOTO1ØØØ
845 TR=TR-1:IFSR=19THENTR=TR+2:REM @ GO ¬
     ¬ON TO NEXT TRACK
850 REM @ TEST FOR END TRACK
855 IFSR=17ANDTR<SPGOTO1ØØØ
860 IFSR=19ANDTR>SPGOTO1ØØØ
865 GOTO7ØØ
1000 REM ** PRINT OUT SUMMARY
1005 K=Ø:B$="H"
1010 PRINTZG$;:PRINTTAB(11)"↓rFILE ¬
     ¬SUMMARY"
1015 PRINT"↓rSEQ #","BLOCKS"," START ",
     ¬" FINISH
1020 PRINT,,"TR  SEC","TR  SEC"
1025 FORJ=1+15*KTO15+15*K
1030 :IFJ>M-1THENJ=15+15*K:GOTO1Ø45
1035 :GOSUB4Ø4Ø:REM @ FORMAT NUMBERS
1040 :PRINT" "J," "S%(J,2),A$,Z$
1045 NEXT
1050 K=K+1:PRINT"↓":GOSUB4Ø3Ø
1055 IFJ<MGOTO1Ø1Ø
1100 REM ** CHOICES
1105 PRINTZG$:PRINT"↓↓↓rCHOICESf:
     ¬     rLfOOK: FIRST 24Ø BYTES
1110 PRINTTAB(12)"↓rSfUMMARY REVIEW
1115 PRINTTAB(12)"↓rRfETRIEVE A FILE
1120 PRINTTAB(12)"↓rBf SCAN OTHER BAND
1125 PRINTTAB(12)"↓r^f DIFFERENT DISK
1130 PRINTTAB(12)"↓rEfXIT PROGRAM
1135 GOSUB4ØØØ:IFA$="L"GOTO12ØØ
1140 IFA$="S"GOTO1ØØØ
1145 IFA$="R"GOTO15ØØ
1150 IFA$="B"THENCLOSE8:GOTO6ØØ
1155 IFA$="^"THENGOSUB4Ø5Ø:RUN4ØØ
1160 IFA$="E"THENGOSUB4Ø5Ø:PRINTZG$:END
1165 GOTO1135
1200 REM ** GET 1ST PAGE OF FILE DATA
1205 INPUT"↓↓↓INPUT TRACK, SECTOR";J,K
1210 IFJ>35ORJ<1GOTO11ØØ
1215 P(Ø)=J:GOSUB5Ø1Ø:IFK<ØORK>SMGOTO11Ø
     ¬Ø
1220 P(1)=K:GOSUB5Ø2Ø:REM @ LNKS L(Ø) ¬
     ¬L(1)
1225 A=2:GOSUB5Ø7Ø:REM @ READ NEXT ¬
     ¬BYTES  (SET BP)
1230 GOSUB5Ø5Ø:PS=A:REM @ START BASIC
1235 GOSUB5Ø5Ø:PL=A:REM @ 1ST PROG LINK
1240 GOSUB5Ø5Ø:PN=A:REM @ 1ST LINE #
1245 A=2:GOSUB5Ø7Ø:REM @ GET STRING
```


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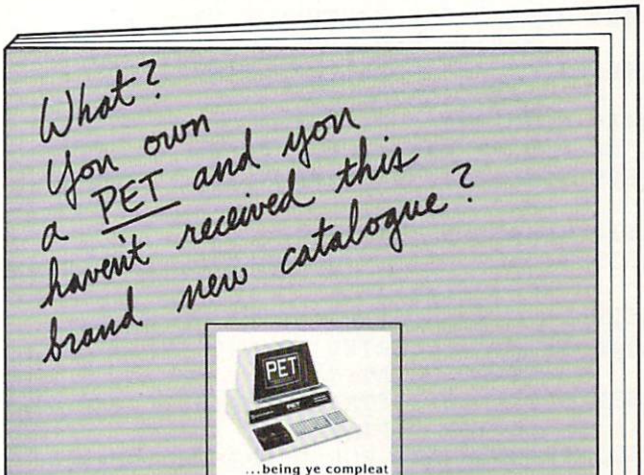

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```
1250 Z$=""
1255 FORJ=ØTO250
1260 :GET#8,A$:GOSUB5Ø6Ø:Z$=Z$+A$
1265 NEXT
1270 Z$=CHR$(L(Ø))+CHR$(L(1))+Z$
1275 PRINTZG$TAB(12)"rFIRST PAGE DATA":
     ¬REM @ PRINT DATA
1280 PRINT,,"↓rTRACK","SECTOR
1285 PRINT"INITIAL BLOCK",P(Ø),P(1)
1290 PRINTTAB(15)"rBYTES
1295 PRINT"BLOCK POINTER"TAB(16)"Ø&1",
     ¬L(Ø),L(1)
1300 PRINTTAB(20)"rDECIMAL VALUE
1305 PRINT"PRGRM START"TAB(16)"2&3"TAB(2
     ¬3)PS
1310 PRINT"1ST LINK"TAB(16)"4&5"TAB(23)P
     ¬L
1315 PRINT"1ST LINE #"TAB(16)"6&7"TAB(23
     ¬)PN
1320 PRINT"rHEX VALUES
1325 FORJ=ØTO5
1330 :A=8*J:GOSUB5Ø8Ø:PRINT"  "A$" :  ";
1335 :FORK=ØTO7
1340 ::A=ASC(MID$(Z$,8*J+K+1,1))
1345 ::GOSUB5Ø8Ø:PRINTA$" ";
1350 :NEXT:PRINT
1355 NEXT
1360 PRINT"↓rCHARACTER VALUES:↓"
1365 K=Ø
1370 FORJ=1TO8Ø
1375 :A=ASC(MID$(Z$,J+8Ø*K,1))
1380 :GOSUB5Ø9Ø
1385 NEXT
1390 PRINT"↓ 'C' TO CONTINUE: +/- ¬
     ¬CHANGE LINE SCAN"
1395 GOSUB4ØØØ:IFA$="C"GOTO11ØØ
1400 IFA$="+"ANDK<2THENPRINT"↑↑↑↑";:
     ¬K=K+1:GOTO137Ø
1405 IFA$="-"ANDK>ØTHENPRINT"↑↑↑↑";:
     ¬K=K-1:GOTO137Ø
1410 GOTO1395
1500 REM ** RETRIEVE A FILE
1505 INPUT"↓↓↓STARTING TRACK, SECTOR";J,
     ¬K
1510 IFJ>35ORJ<1GOTO11ØØ
1515 P(Ø)=J:P(1)=K:GOSUB5Ø1Ø:IFK<ØORK>SM
     ¬GOTO11ØØ
1520 PRINTZG$SPC(1Ø)"rFILE RETRIVAL
1525 PRINT"↓↓RETRIEVING THE FILE ¬
     ¬STARTING AT:"
1530 PRINTTAB(3)"TRACK r"P(Ø)"f"TAB(2Ø)"
     ¬SECTOR r"P(1)
1535 PRINT"↓NAME FOR RETRIEVED FI←↓↓^↑↑L
     ¬E:":INPUT"    ";F$
1540 PRINT"↓IS THIS A rPfROGRAM OR A ¬
     ¬rSfEQUENTIAL FILE"
1545 GOSUB4ØØØ:IFA$="P"THENT$="PRG":
     ¬PRINT"     rPROGRAM":GOTO156Ø
1550 IFA$="S"THENT$="SEQ":PRINT"     ¬
     ¬rSEQUENTIAL":GOTO156Ø
1555 GOTO1545
1560 PRINT"↓PUT GOOD DISK WITH SUFFICIEN
     ¬T BLOCKS          IN DRIVE rØ
1565 PRINT"↓INITIALIZE? (Y/N)":GOSUB4ØØØ
1570 IFA$="Y"THENPRINT#15,"IØ":EL=1535:
     ¬GOSUB51ØØ
1575 GOSUB4Ø3Ø
1580 PRINT"↓rIS EVERYTHING OKf?  TYPE  ¬
     ¬'C'  TO GO!
1585 PRINT"    ↓(ANY OTHER LETTER WILL ¬
     ¬ABORT)↓":GOSUB4ØØØ
1590 IFA$<>"C"GOTO11ØØ
1595 REM ** RETRIEVE PROGRAM
1600 OPEN9,8,4,"Ø:"+F$+","+T$+",WRITE":
     ¬EL=16ØØ:GOSUB51ØØ
1605 EL=1555:GOSUB51ØØ
1610 PRINT"COPYING TRACK:"P(Ø)TAB(21)"SE
     ¬CTOR:"P(1)
1615 GOSUB5Ø2Ø:P(Ø)=L(Ø):P(1)=L(1):
     ¬REM @ GET LINKS
1620 A=255:IFP(Ø)=ØTHENA=P(1)
1625 FORJ=2TOA
1630 :PRINT#15,"M-R";CHR$(J);CHR$(19)
1635 :GET#15,A$:GOSUB5Ø6Ø
1640 :PRINT#9,A$;
1645 NEXT:EL=157Ø
1650 IFP(Ø)<>ØGOTO161Ø:REM @ GET NEXT ¬
     ¬BLOCK
1655 CLOSE9:PRINT"↓rFILE RECOVERED↓":
     ¬GOSUB4Ø3Ø:GOTO11ØØ
4000 REM ** GET AND HOLD
4001 FORA=ØTO1Ø:GETA$:NEXT
4002 GETA$:IFA$=""GOTO4ØØ2
4003 REM @ SCREEN DUMP:IFA$="P"THENGOSUB
     ¬'SCREEN DUMP'
4005 A=VAL(A$)
4009 RETURN
4010 REM ** PRINT DISPLAY OF RECOVERED ¬
     ¬SEQUENCES
4011 PRINTZG$:PRINTTAB(7)"↓RECOVERED ¬
     ¬DISK SEQUENCES
4012 PRINTTAB(12)"↓SEQUENCE"M
4013 PRINT,,"↓TRACK","SECTOR":PRINT"↓rST
     ¬ART",,S%(M,Ø),S%(M,1)
4014 PRINT"↓PRESENT BLOCK":RETURN
4020 REM ** BOTTOM OF DISPLAY
4021 PRINT"↓rEND",,S%(M,3),S%(M,4)
4022 PRINT"↓NUMBER OF BLOCKS",S%(M,2)
4023 PRINT"↓↓ (C-CONT  P-PAUSE  H-HALT  ¬
     ¬S-SUMMARY)
4024 GOSUB4Ø7Ø:RETURN
4030 REM ** TYPE ANY KEY---
4031 PRINTTAB(7)"TYPE ANY KEY TO ¬
     ¬CONTINUE":GOSUB4ØØØ:RETURN
4040 REM ** FORMAT NUMBERS
4041 A$="r"+RIGHT$(STR$(S%(J,Ø)),
     ¬2)+"    "+RIGHT$(STR$(S%(J,1)),
     ¬2)+"f
4042 Z$=RIGHT$(STR$(S%(J,3)),2)+"     ¬
     ¬"+RIGHT$(STR$(S%(J,4)),2)
4043 RETURN
4050 REM ** CLOSE FILES
4051 PRINT#15,"B-P,2,Ø":CLOSE8:CLOSE15:
     ¬RETURN
4060 REM ** PRINT TRACK SUMMARY TABLE
4061 PRINTZG$:PRINTTAB(8)"TRACK ¬
     ¬r"TR"fSUMMARY TABLE
4062 PRINT"SEC ! TR  rInf   SC  |    TR ¬
     ¬ rOUTf  SC
4063 FORJ=ØTOSM:PRINTJ;:FORK=ØTO3
4064 PRINTTAB(5+9*K)D$(P(Ø),J,K);
4065 NEXT:PRINT:PRINT"↑"TAB(4)"!"SPC(14)
     ¬"|":NEXT
4066 GOSUB4Ø7Ø:RETURN
```

```
 4070 REM ** PAUSE/STOP CONTROL
 4071 GETA$:IFA$="H"ORA$="C"ORA$="P"ORA$=
      ¬"S"THENB$=A$
 4072 IFB$="H"THENGOSUB4030:RETURN
 4073 IFB$="P"THENFORJ=0TO5000:NEXT
 4074 GETA$:IFA$="P"THENGOSUB4003:RETURN
 4075 IFA$="H"ORA$="C"ORA$="S"THENB$=A$
 4076 RETURN
 5010 REM ** NUMBER OF BLOCKS IN TRACK
 5011 SM=16:IFP(0)<31THENSM=17
 5012 IFP(0)<25THENSM=19
 5013 IFP(0)<18THENSM=20
 5014 RETURN
 5020 REM ** GET LNKS--P(0)P(1)IN:
      ¬L(0)L(1)OUT--OUT PTRS SET
 5021 PRINT#15,"U1:";2;1;P(0);P(1)
 5022 EL=5021:GOSUB5100
 5023 FORJ=0TO1:REM @ GET LINKS
 5024 :PRINT#15,"M-R";CHR$(J);CHR$(19)
 5026 :GET#15,A$:GOSUB5060
 5028 :L(J)=ASC(A$):D%(P(0),P(1),
      ¬J+2)=L(J)
 5030 NEXT:A=2:GOSUB5070:RETURN
 5040 :REM ** IN POINTERS FOR LINK BLOCK
 5041 :FORJ=0TO1
 5042 ::D%(L(0),L(1),J)=P(J)
 5043 :NEXT:RETURN
 5050 REM ** GET DEC VALUE-2 BYTES
 5051 GET#8,A$:GOSUB5060:REM @ LO
 5052 A=ASC(A$)
 5053 GET#8,A$:GOSUB5060:REM @ HI
 5054 A=ASC(A$)*256+A:RETURN
 5060 REM ** WHEN A$=""
 5061 IFA$=""THENA$=CHR$(0)
 5062 RETURN
 5070 REM ** SET B-P
 5071 PRINT#15,"B-P,2,";A
 5072 EL=5071:GOSUB5100:RETURN
 5080 REM ** DEC>HEX
 5081 A$=MID$(H$,1+(240ANDA)/16,1)+MID$(H
      ¬$,1+(15ANDA),1):GOSUB5060:RETURN
 5090 REM ** ASC > CHARACTERS
 5091 IFA<32THENPRINT"r"CHR$(A+64)"r̂";:
      ¬RETURN
 5092 IFA=34ORA=98THENPRINTCHR$(34)CHR$(3
      ¬4)CHR$(20);:RETURN
 5093 IFA<128GOTO5095
 5094 IFA<160THENPRINT"r"CHR$(A+32)"r̂";:
      ¬RETURN
 5095 PRINTCHR$(A);:RETURN
 5100 REM ** CHECK DISK ERROR
 5101 INPUT#15,EN$,EM$,ET,ES:IFEN$="00"TH
      ¬ENRETURN
 5102 PRINT"↓↓rDISK ERRORr̂ AT PROGRAM ¬
      ¬LINE "EL
 5105 PRINT"↓ERROR MESSAGE: "EN$"  "EM$,
      ¬ET","ES
 5107 IFEN$="22"GOTO1000
 5109 END
READY.
```

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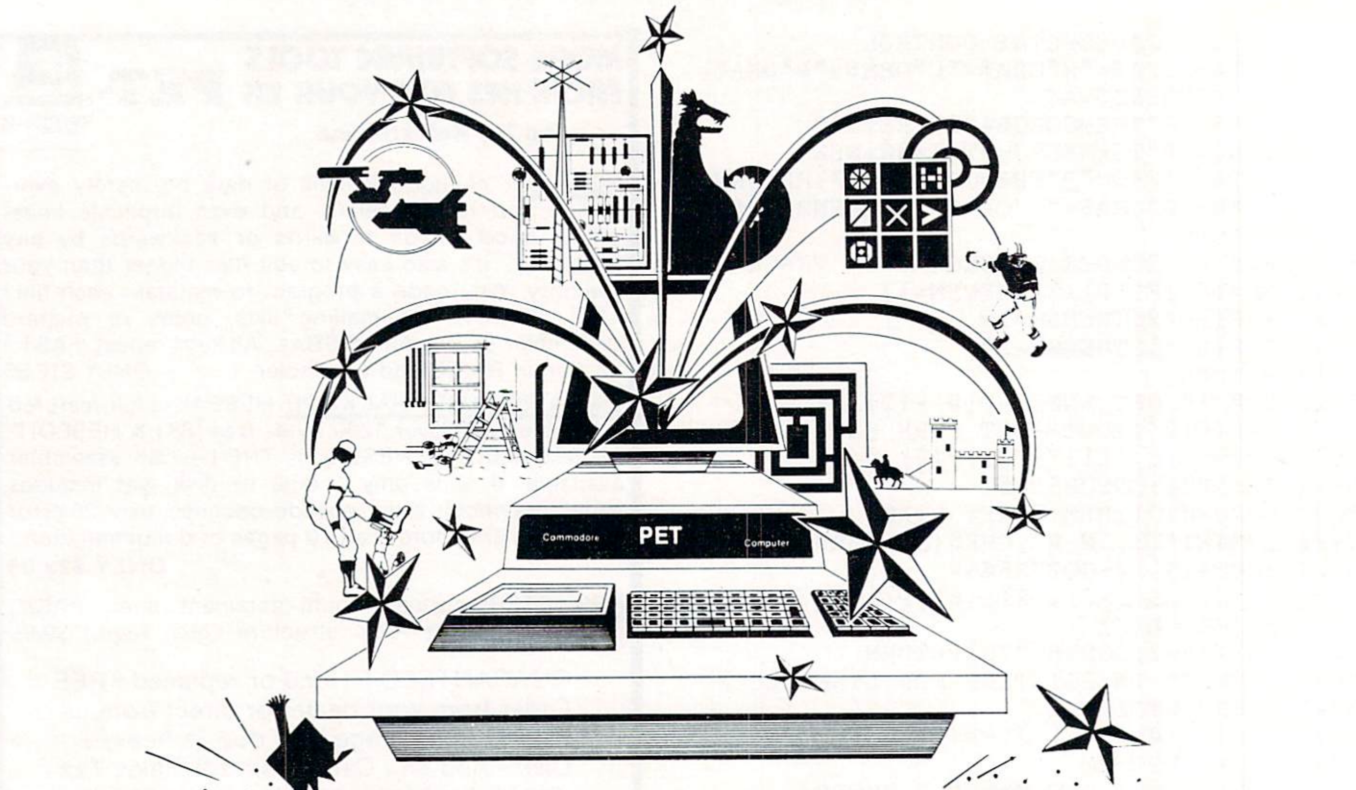

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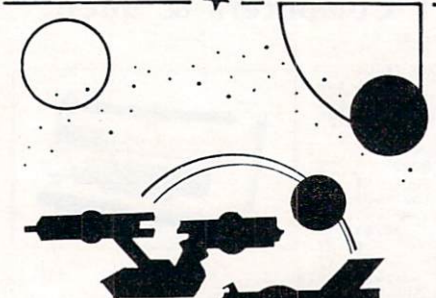

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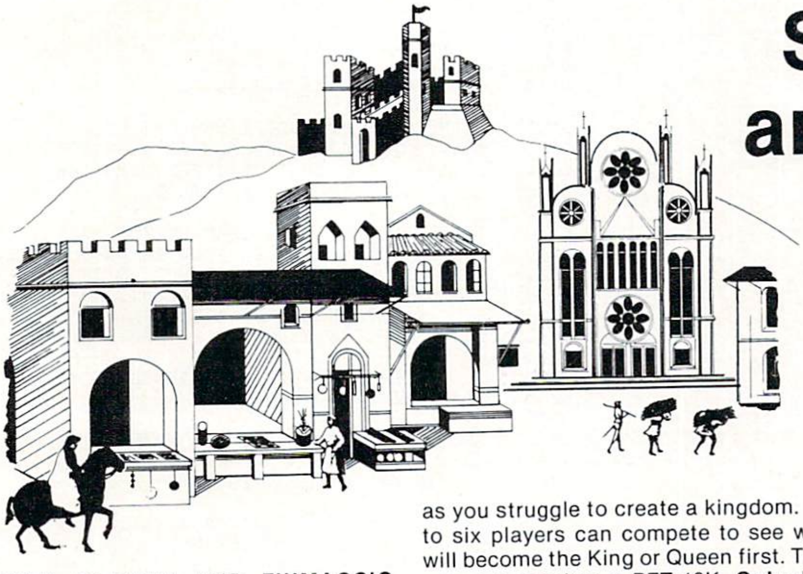

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Pet Exec Hello

Gordon Campbell
Toronto, Canada

When you turn on your Pet, what do you do next? I found that there was a standard set of commands, which went along with the particular diskette being used. For example, for program development, the commands I use are:

POKE 59468, 14 (set upper and lower case)
POKE 59458, 62 (this may damage YOUR machine)
OPEN 1,8,15,"IO" (because DOS is first)
LOAD "BASIC AID", 8 (extensions to BASIC
SYS 7*4096 (invoke BASIC AID)
DISK "$0" (directory)
REPEAT (turn on auto-repeat keyboard)

Eventually, you get tired of issuing the same old commands over and over. So I did something about it. PET EXEC HELLO is a suite of three small programs which allow you to use a 'HELLO' file on disk.

The HELLO file consists of a set of direct commands which are executed when you 'boot' from the disk. The first file on the disk must be the SIGNON program. It prints a greeting, and invokes a machine-language program called EXEC HELLO. EXEC HELLO reads in the whole HELLO file, and feeds it to the keyboard buffer one character at a time. At the end of the commands, EXEC HELLO disengages. BUILD HELLO is a program which helps you create HELLO files.

```
SIGNON     - NOV 26, 1980          PAGE  1

 100    IF PEEK (13) THEN 160
 110    PRINT "QQQpet 'exec hello' in operation
 120    PRINT "Q  for upgrade rom - 32k disk
 130    PRINT "QQ
 140    POKE 13,1
 150    LOAD "exec hello",8
 160    POKE 13,0
 170    SYS 6 * 16 ↑ 3 + 4 * 256
```

```
                  0010 ;      PET EXEC-HELLO
                  0020 ;   FOR 'UPGRADE (3.0) ROM'
                  0030 ;   AS OF NOV 26, 1980
                  0040 ;   SAVED AS 'PEH ML V5'
                  0050 ;
                  0060 ;  COPYRIGHT (C) 1980
                  0070 ;  BY GORDON CAMPBELL
                  0080 ;     36 DOUBLETREE ROAD
                  0090 ;     WILLOWDALE, ONTARIO
                  0100 ;              M2J 3Z4
                  0110 ;    PHONE (416) 492-9518
                  0120 ;
                  0130 ; PERMISSION TO MODIFY OR COPY FOR
                  0140 ; NON-COMMERCIAL PURPOSES IS HEREBY
                  0150 ; GRANTED, PROVIDED THAT THE COPYRIGHT
                  0160 ; AND THIS NOTICE IS RETAINED.
                  0170 ;
                  0180 ; THIS PROGRAM IS INVOKED BY THE BASIC
                  0190 ; PROGRAM 'SIGNON'. IT RUNS IN UNPROTECTED
                  0200 ; MEMORY BY DESIGN, SO IT SHOULD BE
                  0210 ; INVISIBLE TO OTHER OPERATIONS. ANY REALLY
                  0220 ; BIG PROGRAM WILL SMEAR IT. ANYTHING
                  0230 ; WHICH USES INTERRUPTS (EG. AUTO REPEAT
                  0240 ; KEYBOARD) WILL EITHER COME TO GRIEF
                  0250 ; OR SIMPLY DISENGAGE IT. THATS OK IF
                  0260 ; IT'S THE LAST COMMAND.
                  0270 ;
                  0280 ; THE EXCEPTION IS 'LOAD', WHICH I WATCH
                  0290 ; FOR. IF THERE IS A LOAD, I GENERATE
                  0300 ; A 'SYS 0' TO RE-ENGAGE.
                  0310 ;
                  0320 ; TRY TO AVOID DOS COMMANDS WHICH MAY
                  0330 ; CAUSE TROUBLE.  FOR EXAMPLE, USE:
                  0340 ;   LOAD"$0",8
                  0350 ;   LIST
                  0360 ;   NEW       RATHER THAN >$0
                  0370 ;
                  0380              .BA $6400
                  0390              .OS
                  0400 ;
6400- 4C 17 64    0410              JMP ENTRY     ;SKIP AROUND FILENAME
                  0420 ;
                  0430 ;
6403- 48 45 4C    0440 FNAME        .BY 'HELLO,P,R' 0 0 0
6406- 4C 4F 2C
6409- 50 2C 52
640C- 00 00 00
640F- 00 00 00    0450              .BY 0 0 0 0 0 0 0 0
6412- 00 00 00
6415- 00 00
                  0460 ;
6417- A2 00       0470 ENTRY        LDX #0
6419- BD 03 64    0480 SHLOOP       LDA FNAME,X   ; FIND LENGTH
641C- F0 03       0490              BEQ LENFND    ; OF FILENAME
641E- E8          0500              INX
641F- D0 F8       0510              BNE SHLOOP    ; JUMP
                  0520 ;
6421- 8E 7A 65    0530 LENFND       STX FNLEN
                  0540 ;
6424- A9 0F       0550              LDA #$0F      ; OPEN
6426- 85 D2       0560              STA *FNUM     ; CONTROL
6428- A9 08       0570              LDA #8
642A- 85 D4       0580              STA *DEV      ; CHANNEL
642C- A9 0F       0590              LDA #$0F      ; 15,8,15
642E- 09 60       0600              ORA #$60
6430- 85 D3       0610              STA *SCNDRY
6432- A9 00       0620              LDA #0
6434- 85 D1       0630              STA *OPLEN    ; NO FILENAME
6436- 85 96       0640              STA *ST
6438- 20 24 F5    0650              JSR OPEN      ; ROM ROUTINE
                  0660 ;
643B- A9 08       0670              LDA #8        ; OPEN
643D- 85 D2       0680              STA *FNUM     ; TEXT
643F- 85 D4       0690              STA *DEV      ; FILE
6441- 09 60       0700              ORA #$60      ; 8,8,8
6443- 85 D3       0710              STA *SCNDRY
6445- AD 7A 65    0720              LDA FNLEN     ; LENGTH OF
6448- 85 D1       0730              STA *OPLEN    ; FILE NAME
644A- A9 64       0740              LDA #H,FNAME
644C- 85 DB       0750              STA *FNPTR+1          ; AND IT'S
644E- A9 03       0760              LDA #L,FNAME          ; ADDRESS
6450- 85 DA       0770              STA *FNPTR
6452- A9 00       0780              LDA #0
6454- 85 96       0790              STA *ST
6456- 20 24 F5    0800              JSR OPEN      ; ROM ROUTINE
                  0810 ;
6459- 20 C1 64    0820              JSR ERRCHK
                  0830 ;
645C- A9 02       0840              LDA #2        ; SKIP PAST
645E- 8D 7B 65    0850              STA NCHRS     ; LOAD-ADDRESS
```

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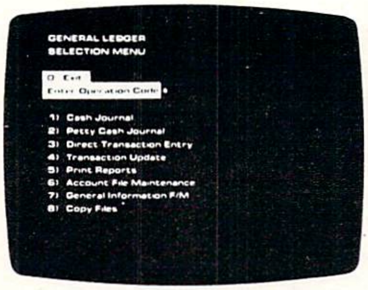

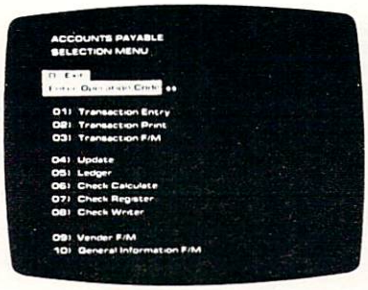

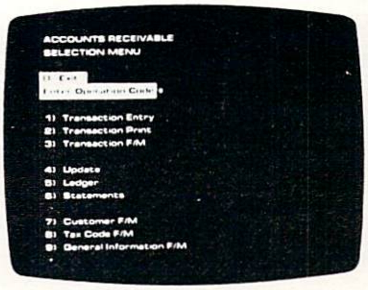

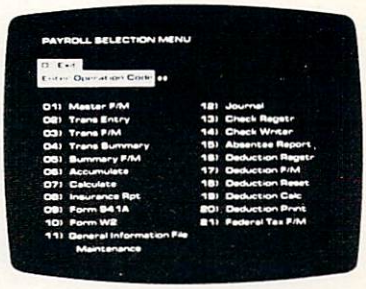

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- Allows For Automatic Progress Billing.
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- Automatic Posting To General Ledger . . . .

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See your nearest Commodore dealer for a demonstration of this outstanding business software system.

CMS Software Systems

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Program Operation

As I said earlier, the first program on the disk must be SIGNON. Thus, after turning on the Pet, key the following:

CLR 4 spaces "*",8 Home RUN

This causes the first program on the disk to be loaded and run. Very quickly, you see the commands which were entered earlier using BUILD HELLO, appear on the screen. At the end of the HELLO file you regain control at the keyboard. (Or earlier if one of the commands disengages EXEC HELLO).

Program Details

SIGNON

This tiny program uses one trick. Since a LOAD command issued by a program will cause a restart, location 13 is used as a flag that we are restarting after loading the machine-language program. This location normally contains a zero.

BUILD HELLO

This program does very straightforward text entry. I chose to save the HELLO text as a program file on disk, so the text is poked into memory, and the machine-language monitor invoked to save the results. The cursor-control keys are thus all active, and characters such as double-quote and comma cannot cause any problem. The only checking done in the program is to ensure that the text is not too large for the area allocated to it in EXEC HELLO.

EXEC HELLO

The first thing done in EXEC HELLO is to count the number of characters in the filename. This allows the name to be changed by POKE's without having to re-assemble the program. Next the error-channel and the text file are opened. The error-channel is interrogated to make sure there is a HELLO file on the disk. If not, the message *ERROR* is printed on the screen and the program breaks into the monitor. The next file is read into memory, and both channels are closed. The part of the

```
6461- A2 08               LDX #8        ; SET INPUT CHANNEL
6463- 20 C6 FF            JSR SETIN     ; FOR TEXT FILE
6466- 20 E4 FF  PASSJK    JSR GET
6469- CE 7B 65            DEC NCHRS
646C- D0 F8               BNE PASSJK
                ;
646E- AD 78 65            LDA MYPTR     ; SET UP FOR
6471- 85 01               STA *PTR      ; INDIRECT
6473- AD 79 65            LDA MYPTR+1   ; ADDRESSING
6476- 85 02               STA *PTR+1
6478- A0 00               LDY #0
647A- 8C 7F 65            STY SVY
                ;
647D- 20 E4 FF  CHRGET    JSR GET
6480- C9 FC               CMP #252      ; END OF FILE CHARACTER
6482- F0 11               BEQ DONE
6484- AC 7F 65            LDY SVY
6487- 91 01               STA (PTR),Y
6489- 88                  DEY
648A- 8C 7F 65            STY SVY
648D- C0 FF               CPY #$FF
648F- D0 EC               BNE CHRGET
6491- C6 02               DEC *PTR+1
6493- D0 E8               BNE CHRGET    ; JUMP, OR I'M DEAD
                ;
6495- AC 7F 65  DONE      LDY SVY
6498- 91 01               STA (PTR),Y   ; STORE EOF
649A- 20 CC FF            JSR RESCHN    ; RESTORE CHANNEL
                ;
649D- A9 08               LDA #8
649F- 20 AE F2            JSR CLOSE
64A2- A9 0F               LDA #15
64A4- 20 AE F2            JSR CLOSE
                ;
64A7- A5 90     CONECT    LDA *INTHND   ;          A BIT OF
64A9- 8D E8 64            STA GOBACK+1          ; ROM INDEPENCE
64AC- A5 91               LDA *INTHND+1
64AE- 8D E9 64            STA GOBACK+2
64B1- 78                  SEI   ; NO INTERRUPTS
64B2- A9 E3               LDA #L,INTRTN
64B4- 85 90               STA *INTHND   ; CONNECT
64B6- A9 64               LDA #H,INTRTN
64B8- 85 91               STA *INTHND+1
64BA- 58                  CLI
64BB- A9 00               LDA #0
64BD- 8D 7E 65            STA SVX
64C0- 60                  RTS   ; THATS ALL FOLKS
                ;
                ; EXEC FILE NOW RUNNING
                ;
                ;
64C1- A2 0F     ERRCHK    LDX #15       ; FILE NUMBER
64C3- 20 C6 FF            JSR SETIN     ; SET INPUT CHANNEL
64C6- 20 E4 FF  GER       JSR GET
64C9- C9 30               CMP #$30      ; ZERO?
64CB- F0 F9               BEQ GER       ; OK, GET ANOTHER
64CD- C9 2C               CMP #$2C      ; COMMA?
64CF- D0 04               BNE ERR       ; NO - MUST BE BAD
64D1- 20 CC FF            JSR RESCHN
64D4- 60                  RTS
                ;
                ;
64D5- A2 13     ERR       LDX #ERMSG+256-ERMEND
                ; PRINT *ERROR*
64D7- BD 78 64  ERLOOP    LDA ERMEND-256,X
64DA- 20 D2 FF            JSR PRINT
64DD- E8                  INX
64DE- D0 F7               BNE ERLOOP
64E0- 00                  BRK
64E1- 00                  BRK
64E2- 00                  BRK
                ;
                ;
                ; INTERRUPT ROUTINE
                ;
64E3- A5 9E     INTRTN    LDA *KBUFNO
                ; LAST CHARACTER PROCESSED?
64E5- F0 03               BEQ SENCHR    ; YUP; GIVE HIM ANOTHER
64E7- 4C 00 00  GOBACK    JMP $0000
                ;
                ; ABOVE ADDRESS WILL BE FILLED IN
                ; BY THE PROGRAM DURING EXECUTION
                ; AS THE NORMAL INTERRUPT HANDLER
                ;
64EA- A5 01     SENCHR    LDA *PTR      ; SAVE 'USR'
64EC- 8D 7C 65            STA SVPTR     ; VECTOR
64EF- A5 02               LDA *PTR+1    ; (PROBABLY DON'T
64F1- 8D 7D 65            STA SVPTR+1   ; HAVE TO)
64F4- AD 78 65            LDA MYPTR
64F7- 85 01               STA *PTR      ; SET UP MY
64F9- AD 79 65            LDA MYPTR+1   ; INDIRECT
```

program which feeds characters into the keyboard buffer is hooked in to the interrupt processor, and control is returned to BASIC. The interrupt routine sees if there are any characters in the buffer, and if not, deposits one. It looks at the text being passed, and if the word LOAD appears, sets a flag. At the end of a line, if the flag is set, then the USR vector is pointed at the re-connect routine in EXEC HELLO, and a SYS 0 added to the content of the keyboard buffer. At the end of the text everything is restored as it was.

EXEC HELLO tries to be transparent to the rest of the Pet, so it sits in unprotected memory. This means it could be clobbered if the commands RUN a program, and cause it to process far enough to build variables on top of EXEC HELLO. Note also the warnings in the comments at the start of the listing.

What next

EXEC HELLO could be modified to handle just about any purpose where running a program would cause problems but direct commands will work. Several of these cases (such as dumping the contents of a tape to disk) are handled by utility programs, but with EXEC HELLO the only thing you have to do to handle a new requirement is to change the direct commands on the HELLO file.

If you wish to obtain a disk containing PET EXEC HELLO along with a number of other programs, please send $12 to the author. If you do key it in or send for a disk, please give it to all your friends.

```
64FC- 85 02                     STA *PTR+1     ; ADDRESS
64FE- A0 00                     LDY #0
                     ;
6500- B1 01                     LDA (PTR),Y
6502- C9 FC                     CMP #252       ; END OF FILE?
6504- F0 65                     BEQ UNHOOK     ; YES
6506- 8D 6F 02                  STA KEYBUF
6509- A2 01                     LDX #1         ; PRETEND IT CAME
650B- 86 9E                     STX *KBUFNO    ; FROM KEYBOARD
                     ;
650D- AE 7C 65                  LDX SVPTR      ; RESTORE
6510- 86 01                     STX *PTR       ; 'USR' VECTOR
6512- AE 7D 65                  LDX SVPTR+1
6515- 86 02                     STX *PTR+1
                     ;
6517- C9 0D                     CMP #$0D       ; CR?
6519- D0 24                     BNE NOCR       ; NOPE
651B- AD 80 65                  LDA LFLG       ; DID WE SAY 'LOAD'?
651E- F0 1F                     BEQ NOCR       ; NOPE
                     ;
6520- A9 00                     LDA #0         ; RESTORE FLAG
6522- 8D 80 65                  STA LFLG
6525- A2 05                     LDX #5         ; SAY SYS0 $0D
6527- BD 85 65       SYSLOP     LDA SYS,X
652A- 9D 6F 02                  STA KEYBUF,X
652D- CA                        DEX
652E- D0 F7                     BNE SYSLOP
                     ;
6530- A2 06                     LDX #6         ; 6 CHARACTERS
6532- 86 9E                     STX *KBUFNO
6534- A9 A7                     LDA #L,CONECT          ; SET UP
6536- 85 01                     STA *PTR       ;         RESTORE
6538- A9 64                     LDA #H,CONECT          ; HOOK
653A- 85 02                     STA *PTR+1
653C- 4C 6B 65                  JMP UNHOOK
                     ;
653F- AE 7E 65       NOCR       LDX SVX        ; WATCH
6542- DD 81 65                  CMP LOAD,X     ; OUT FOR
6545- F0 07                     BEQ CHKLD      ; 'LOAD'
6547- A9 00                     LDA #0
6549- 8D 7E 65                  STA SVX
654C- F0 0D                     BEQ ENCHKL     ; JUMP
                     ;
654E- E8             CHKLD      INX
654F- 8E 7E 65                  STX SVX
6552- E0 04                     CPX #4         ; WHOLE WORD?
6554- D0 05                     BNE ENCHKL     ; NOT YET
6556- A9 01                     LDA #1
6558- 8D 80 65                  STA LFLG       ; SET FLAG
                     ;
655B- A9 FF          ENCHKL     LDA #$FF
655D- CE 78 65                  DEC MYPTR      ; DOUBLE
6560- CD 78 65                  CMP MYPTR      ; DECREMENT
6563- D0 03                     BNE BACK
6565- CE 79 65                  DEC MYPTR+1
6568- 4C E7 64       BACK       JMP GOBACK     ; SEE YOU SOON
                     ;
656B- AD E8 64       UNHOOK     LDA GOBACK+1           ; RESTORE
656E- 85 90                     STA *INTHND    ;         INTERRUPT
6570- AD E9 64                  LDA GOBACK+2           ; VECTOR
6573- 85 91                     STA *INTHND+1
6575- 4C E7 64                  JMP GOBACK
                     ;
                     ERMEND
                     ;
                     ;
                     ; WORK AREA
                     ;
6578- 00 67          MYPTR      .SE $6700      ; TOP OF TEXT AREA
657A-                FNLEN      .DS 1          ; LENGTH OF FILE NAME
657B-                NCHRS      .DS 1          ; # CHARS TO SKIP
657C-                SVPTR      .DS 2          ; POINTER SAVE AREA
657E-                SVX        .DS 1          ; X REG SAVE AREA
657F-                SVY        .DS 1          ; Y REG SAVE AREA
6580- 00             LFLG       .BY 0          ; =1: THIS LINE
                                ;                CONTAINED A 'LOAD'
6581- 4C 4F 41       LOAD       .BY 'LOAD'
6584- 44
6585- 20 53 59       SYS        .BY ' SYS0' $0D
6588- 53 30 0D
658B- 2A 45 52       ERMSG      .BY '*ERROR*'
658E- 52 4F 52
6591- 2A
                     ;
                     ;
                     ; EQUATES
                     ;
                     PTR        .DE 1          ; INDIRECT ADDRESS
                     ;
                     INTHND     .DE $90        ; INT HANDLER
```

```
2620 ST         .DE $96      ; STATUS
2630 KBUFNO     .DE $9E      ; # CHARS IN BUFFER
2640 OPLEN      .DE $D1      ; LEN OF FILE NAME
2650 FNUM       .DE $D2      ; FILE NUMBER
2660 SCNDRY     .DE $D3      ; SECONDARY ADDRESS
2670 DEV        .DE $D4      ; DEVICE NUMBER
2680 FNPTR      .DE $DA      ; ADDRESS OF NAME
2690 KEYBUF     .DE $26F     ; KEYBOARD BUFFER
2700 ;
2710 ;
2720 ; TWO NON-STANDARD ROM ADDRESSES
2730 ;
2740 CLOSE      .DE $F2AE
2750 OPEN       .DE $F524
2760 ;
2770 SETIN      .DE $FFC6    ; SET CHANNEL
2780 RESCHN     .DE $FFCC    ; RESET IT
2790 GET        .DE $FFE4
2800 PRINT      .DE $FFD2
2810            .EN
```

```
LABEL FILE:  [ / = EXTERNAL ]

FNAME=6403          ENTRY=6417          SHLOOP=6419
LENFND=6421         PASSJK=6466         CHRGET=647D
DONE=6495           CONECT=64A7         ERRCHK=64C1
GER=64C6            ERR=64D5            ERLOOP=64D7
INTRTN=64E3         GOBACK=64E7         SENCHR=64EA
SYSLOP=6527         NOCR=653F           CHKLD=654E
ENCHKL=655B         BACK=6568           UNHOOK=656B
ERMEND=6578         MYPTR=6578          FNLEN=657A
NCHRS=657B          SVPTR=657C          SVX=657E
SVY=657F            LFLG=6580           LOAD=6581
SYS=6585            ERMSG=658B          /PTR=0001
/INTHND=0090        /ST=0096            /KBUFNO=009E
/OPLEN=00D1         /FNUM=00D2          /SCNDRY=00D3
/DEV=00D4           /FNPTR=00DA         /KEYBUF=026F
/CLOSE=F2AE         /OPEN=F524          /SETIN=FFC6
/RESCHN=FFCC        /GET=FFE4           /PRINT=FFD2

//0000,6592,6592
```

```
100   UL = PEEK (59468):
       POKE 59468,14
110   PRINT "Si help you create 'hello'
120   PRINT "files on disk (drive zero).
130   PRINT "Qsorry, i'm not a full text editor;
140   PRINT "use 'stop' if you change your mind.
150   PRINT "Quse shift @ to signal the end.Q
160   SL = 3 * 16 ↑ 3:
      MX = SL + 350
170   POKE 170,0
180   GET A$:
       IF A$ = "" THEN 170
190   IF A$ = "@" THEN 260
200   POKE SL, ASC (A$)
210   X = FRE (0)
220   SL = SL + 1
230   IF SL > MX THEN PRINT:
       PRINT "Qsorry, this hello file is
       too big.":
       POKE 59468,UL:
       STOP
240   PRINT A$;
250   GOTO 170
260   OPEN 15,8,15,"s0:hello"
270   CLOSE 15
280   POKE SL,252
290   SL = SL + 1
300   DIM X$(15)
310   FOR J = 0 TO 15:
       READ X$(J):
       NEXT
320   A1 = INT (SL / 16 ↑ 3)
330   SL = SL - 16 ↑ 3 * A1
340   A2 = INT (SL / 256)
350   SL = SL - 256 * A2
360   A3 = INT (SL / 16)
370   A4 = SL - 16 * A3
380   PRINT "QQQQQQQQQ.s " CHR$ (34)"0:
      hello";
390   PRINT CHR$ (34)",08,3000,"X$(A1)X$
      (A2)X$(A3)X$(A4)
400   PRINT ".x"
410   PRINT "QQQQQQQ"
420   POKE 59468,UL
430   POKE 623,13:
       POKE 624,13:
       POKE 158,2
440   SYS 64785
450   END:
       REM NEVER EXECUTED
460   DATA 0,1,2,3,4,5,6,7
470   DATA 8,9,A,B,C,D,E,F
```

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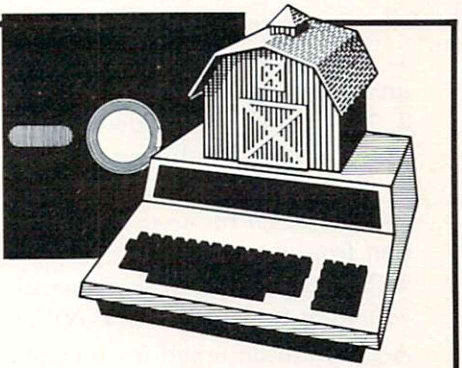

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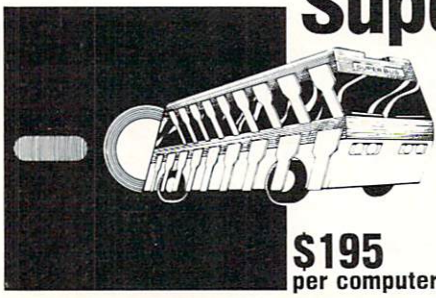

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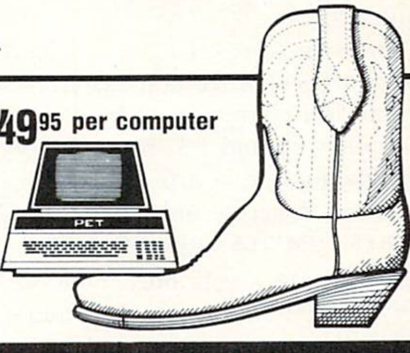

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A Flexible Input Subroutine

Glenn M. Kleiman Research Triangle Park, NC

Many interactive programs require a variety of types of input from the user. For example, in my own programs written for classroom use by children, each of the following four types of input are often required:

1. Alphabetic strings, such as the user's name or answers to questions.
2. Numbers, such as the user's age or the answers to math problems.
3. Single digits or letters from a restricted set, such as when the user is asked to make a selection from a menu.
4. Y or N, in response to questions such as "Do you want to continue? (Y/N)".

A program designed for unsophisticated users must have checks that the user's input is appropriate. For example, the programmer must guard against the uncertain user who, when given a Yes/No question, presses M for "maybe". Often, particularly in programs to be used by children, one should also control the number of characters that can be input. A program should not accept a name consisting of 100 letters, nor should it accept 15 digits in answer to a math problem that calls for a 3 digit answer. Furthermore, the user should be able to erase mistakes, and inappropriate responses should not stop program execution.

I have written a general purpose input subroutine to handle all of the above. It is written for the PET, but most of the routine is compatible with other BASICs, so it can be easily revised for other microcomputers.

Within a program using this subroutine, the accepted inputs are specified by assigning values to variables before the subroutine is called. The main variable is UF, which can have any one of four values. If UF = 0 (the default value), any letters, but no other characters, will be accepted. If UF = 1 then only numbers will be accepted. For both letters and numbers, UM controls the maximum number of input characters. The default value for UM is set to 1 in line 300.

In order to restrict the accepted characters, as for menu selection responses, UF is set to 2, and the first and last characters to be accepted are assigned to variables F$ and L$, respectively. For example, the following line in a program will set the subroutine to accept only the letters M, N, O, and P:
UF = 2:F$ = "M":L$ = "P":GOSUB300

Finally, to accept only Y or N, UF is set to 3. If UF = 2 or 3, UM is set to 1 automatically.

In all cases, inappropriate input is ignored. Input characters can be erased by pressing the DEL key and a completed input is signaled by pressing RETURN. DEL and RETURN are not accepted until at least one character has been input. Once UM characters have been input, only DEL and RETURN will be accepted.

When RETURN is pressed, UF and UM are reset to their default values. Input strings are then available in the program as variable IN$, input numerics as IN.

A few other notes. I use a flashing ? as a cursor, but any character can be substituted in line 420. In line 430, UT = TI + 35 controls the rate of cursor flashing. The flashing rate of 35 jiffies is slower than most cursors, but seems to be less annoying to many people than the usual speed. The technique of flashing the cursor is based on the INP routine from CURSOR #4. This subroutine, and any other frequently used one, should be placed at the beginning of the program. The reason is that whenever a GOSUB (or a GOTO) occurs, the sequential search for the referenced line number begins at the first line of the program. An input subroutine placed at the end of a long program may be noticeably slow in accepting responses.

This subroutine, written to be easily readable rather than compact, uses 406 bytes (without the REMs).

```
100 REM     FLEXIBLE INPUT SUBROUTINE
101 REM
102 REM         GLENN M. KLEIMAN
103 REM          TEACHING TOOLS:
104 REM       MICROCOMPUTER SERVICES
105 REM          P.O. BOX 12679
106 REM       RESEARCH TRIANGLE PARK
107 REM            N.C. 27709
110 REM
120 REM     VARIABLES TO BE SET:
130 REM  UF=0 FOR ALPHABETIC INPUT
140 REM  UF=1 FOR NUMERIC INPUT
150 REM  UF=2 FOR RESTRICTED INPUT
160 REM  UF=3 FOR Y OR N INPUT
170 REM
180 REM  IF UF=0 OR 1 SPECIFY:
190 REM     UM = MAXIMUM NUMBER OF INPUT CHARACTERS
200 REM     (DEFAULT UM SET IN LINE 300)
210 REM  IF UF=2, SPECIFY:
220 REM     F$=FIRST CHARACTER ACCEPTED
230 REM     L$=LAST CHARACTER ACCEPTED
240 REM
250 REM     OUTPUT VARIABLES
260 REM  IN$ = INPUT STRING
270 REM  IN = VAL(IN$)
280 REM
300 IFUM=0THENUM=1
310 IFUF=0THENF$="A":L$="Z"
320 IFUF=1THENF$="0":L$="9"
330 IFUF>1THENUM=1
340 IN$="":UT=TI:UC=1
400 GETU$:IFU$<>""GOTO440
410 IFUT>TIGOTO400
420 PRINTMID$(" ?",UC,1);"←";
430 UC=3-UC:UT=TI+35:GOTO400
440 UL=LEN(IN$):IFUL=UMGOTO510
450 IFUF<>3GOTO480
460 IFU$="Y"ORU$="N"GOTO490
470 GOTO500
480 IFU$<F$ORU$>L$GOTO500
490 IN$=IN$+U$:PRINTU$;:GOTO400
500 IFUL=0GOTO400
510 IFU$=CHR$(20)THENIN$=LEFT$(IN$,UL-1):PRINT" ←← ←";
520 IFU$<>CHR$(13)GOTO400
530 PRINT" ":UF=0:UM=0:IN=VAL(IN$):RETURN
READY.
```

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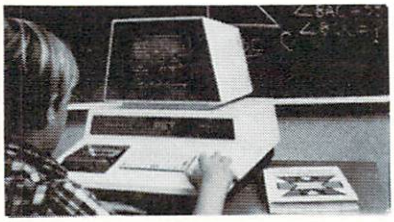
Skyles Electric Works

Q. Your students are gathering around the several PET computers in your classroom. And they all are hungry for hands-on turns at the keyboards. Some students are just beginning to understand computers; others are so advanced they can help you clean up the programs at the end of the period. How do you set up a job queue, how do you keep the beginners from crashing a program, how do you let the advanced students have full access? And how do you preserve your sanity while all this is going on?



A. With the Regent.

Q. What is the Regent?

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Up to 15 PETs, one dual disk drive and as many as five printers can interface with the Regent, and do all those good things we promised. It's designed to operate with 8K, 16K, 32K PET/CBM models and with the Commodore disk drives and new DOS.

Five levels of user privilege, from the Systems Level, through Levels One and Two, Student; Levels One and Two, Operator. From only the use of system commands to complete control for the exclusive use of the instructor.

There's complete system protection against the novice user crashing the program; the instructor has total control over, and receives reports concerning, usage of all PETs.

A complete set of explanations for all user commands is stored on the disk for instant access by all users. And a printout of the record of all usage of Regent is available at the instructor's command.

The Regent includes a systems disk with 100,000-plus bytes for program storage, a ROM program module, together with a Proctor and a SUB-it . . . and complete instructor and student user manuals.

Q. SUB-it? Proctor? What are they?

A. **The SUB-it** is a single ROM chip (on an interface board in the case of the original 2001-8 models) that allows up to 15 PETs to be connected to a common disk via the standard PET-IEEE cables. The Commodore 2040, 2050 or 8050 dual disks and a printer may be used.

(The SUB-it has no system software or hardware to supervise access to the IEEE bus. The system is thus unprotected from user-created problems. Any user—even a rank novice—has full access to all commands and to the disk and bus. This situation can, of course be corrected partially by the Proctor, completely by the Regent.)

The SUB-it prevents inadvertant disruption when one unit in a system is loading and another is being used.

The Proctor takes charge of the bus and resolves multiple user conflicts. Each student can load down from the same disk but cannot inadvertently load to or wipe out the disk. Good for computer aided instruction and for library applications, offering hundreds of programs to beginning computer users.

A combination of hardware and software protects the disk from unexpected erasures and settles IEEE bus usage conflicts. Only the instructor or a delegate can send programs to the disk. Yet all the PETs in the system have access to all disk programs. Available for all PET/CBM models. SUB-it and PET intercontrol module and DLW (down-loading software) are included.

Q. How expensive are these classroom miracles?

A. We think the word is **inexpensive**. The **Regent** system is **$250** for the first PET; **$150** for each additional PET in the system. The **SUB-it** is **$40**. (Add an interface board at **$22.50** if the PET is an original 2001-8.) And the **Proctor** is $95.

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Universal Tape Append For PET/CBM

Roy Busdiecker
Woodbridge, VA

Many times we run into the situation where we'd like to combine programs which have been SAVEd separately. Typical examples include subroutines which can be used in many different programs; interest calculations for mortgage, loan, or savings programs; complex arithmetic for math or engineering programs; and sorting routines for data processing applications.

Owners of Commodore PET/CBM 2001-series computers have several alternatives. Several firms offer a plug-in ROM (read-only memory) in the $50 to $100 range, which adds an APPEND command to the normal instruction repertoire.

The program described here allows owners of Version 1 (BASIC 2.0), Version 2 (BASIC 3.0), or 8000 series (BASIC 4.0) PET/CBM computers automatically to combine two or more programs which were saved on cassette from either one of those two computers.

In use, the program is extremely simple. First, LOAD this APPEND program from its cassette. Next, take the APPEND cassette out of the recorder, and replace it with the cassette that has the first program you want to append to it. DO NOT LOAD the second cassette, but RUN the APPEND program that is already in the computer. You'll be instructed to "Press Play on Cassette #1", and once you do that, the program takes over. After the first program has been added, take out the cassette and insert the second one you want to add. When you RUN the APPEND program again, it will once more ask you to "Press Play...", then add the second program at the end of the first. After you've combined all the programs you want to join, delete the BASIC Append routine (type each line number, 0 through 29, pressing 'RETURN' after each), and use the BASIC SAVE command to store the combined version.

Preparing Programs to be Combined

A few rules must be observed with regard to the programs which are to be joined. In general, you must assure that there is no overlap in line numbers between the two (or more) programs. For example, if you have two programs where one contains lines numbered from 100 to 500 and the other contains lines 300 to 700, the computer's operating system will not react 'normally' if the two are appended. An easy 'fix' is to renumber one program or the other, so that none of its line numbers fall in the range of numbers used in the other program. An exception to this rule is the Append routine itself, because it will be deleted before you start using the combined programs.

When programs are appended, the one(s) with lower line numbers should be done first, to avoid problems.

Some programs, especially those prepared commercially, were SAVEd from the Monitor rather than BASIC, and contain machine language instructions ahead of the BASIC routines. These may not be combined using this program unless the BASIC and machine language sections are "broken apart" and stored separately. You may be able to figure out how to do this by careful study of this article and some experimentation...but be sure that you have backup copies of everything critical before you start! If the APPEND program detects one of these (relatively unusual) programs, it will give you an error message and stop without trying to do the APPEND.

As long as you have sufficient room left in the computers free memory, you may keep adding programs. If you try to add a program which requires more than the remaining free space, the program will print an error message and not attempt to APPEND.

How the Program Works

Actually there are two separate programs which work together to do the job. The first (Figure 1) is a machine-language routine, loaded in the second cassette buffer, which inspects the program in the BASIC text area and calculates where the BASIC program ends.

```
C*
      PC   IRQ  SR AC XR YR SP
.;   C6FB E62E 3A 9E 36 34 FA
.
.:   033A B8 08 A9 01 8D 55 03 69
.:   0342 01 8D 4F 03 A9 04 8D 50
.:   034A 03 8D 56 03 AD B9 08 F0
.:   0352 18 AA AD B8 08 8D 55 03
.:   035A 69 01 8D 4F 03 8A 8D 56
.:   0362 03 69 00 8D 50 03 4C 4E
.:   036A 03 AD 55 03 8D 3A 03 AD
.:   0372 56 03 8D 3B 03 60 FE B7
.
```

Figure 1a. Machine Language Program Listing (Monitor Version, for entering in computer).

The BASIC Append routine (Figure 2) uses the machine-language routine to find the end of the current program in memory. Then it uses one of the built-in ROM (read-only memory) routines to find the "header" on the cassette tape at the beginning of the SAVEd program. That header contains the start-

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```
.,   033C A9 01      LDA #$01
.,   033E 8D 55 03 STA $0355
.,   0341 69 01      ADC #$01
.,   0343 8D 4F 03 STA $034F
.,   0346 A9 04      LDA #$04
.,   0348 8D 50 03 STA $0350
.,   034B 8D 56 03 STA $0356
.,   034E AD B9 08 LDA $08B9
.,   0351 F0 18      BEQ $036B
.,   0353 AA         TAX
.,   0354 AD B8 08 LDA $08B8
.,   0357 8D 55 03 STA $0355
.,   035A 69 01      ADC #$01
.,   035C 8D 4F 03 STA $034F
.,   035F 8A         TXA
.,   0360 8D 56 03 STA $0356
.,   0363 69 00      ADC #$00
.,   0365 8D 50 03 STA $0350
.,   0368 4C 4E 03 JMP $034E
.,   036B AD 55 03 LDA $0355
.,   036E 8D 3A 03 STA $033A
.,   0371 AD 56 03 LDA $0356
.,   0374 8D 3B 03 STA $033B
.,   0377 60         RTS
```

Figure 1b. Machine Language Program (Disassembly Listing)

ing and ending addresses from which its program was saved, and knowing those values allows us to calculate the length of the program on tape.

Armed with knowledge of the end of the current program in memory, and the length of the program to be appended, we can calculate new starting and ending locations for loading the program from tape. By changing those values before we bring the program in from the computer, we can start loading the new program right where the old one ends.

Complications

Back when there was only one operating system (set of ROMs) for the PET, the APPEND routine was much simpler. The second version (BASIC 3.0) made several changes which increased the challenge in designing an APPEND program to run on either version and APPEND a tape which had been created on either version. Appearance of BASIC 4.0 in the 8000 series complicated matters further. There are now nine possible combinations, as depicted in Figure 3.

The first problem, and most obvious, is that the various "built-in" routines used by the program are in different locations in the two versions. Furthermore, some "fixing-up" which is done automatically in BASIC 2.0 by the tape load routine requires calls to other routines in BASIC 3.0 and 4.0. A summary of these differences is shown in Figure 4.

```
0 REM-SUPER APPEND-FOR PET/CBM, COPYRIGHT OCT 79 BY ROY BUSDIECKER
1 P=256:SYS828:PRINTPEEK(826)+P*PEEK(827):PV=PEEK(50003):PRINT"]QQQQQQQ"
2 GOSUB12:A1=PEEK(826)+P*PEEK(827)-1:A2%=A1/256:A3=A1-P*A2%:IFPV=160THEN16
3 ONPV+1GOTO14,15
4 P=256:B1=PEEK(635)+P*PEEK(636):B2=PEEK(637)+P*PEEK(638):IFPEEK(636)<>4THEN27
5 IFPEEK(635)=0THEN8
6 IFPEEK(635)=1THENA1=A1+1:A2%=A1/256:A3=A1-P*A2%:GOTO8
7 GOTO27
8 B3=B2-B1+A1:C1%=B3/256:C2=B3-P*C1%:POKE635,A3:POKE636,A2%:POKE637,C2
9 POKE638,C1%:IFC1%>PEEK(53)ORC1%=PEEK(53)ANDC2>=PEEK(52)THEN29
10 IFPV=160THEN23
11 ONPV+1GOTO17,18
12 IFPV=160THENPOKE158,9:BU=623:FORI=BUTOBU+8:POKEI,13:NEXT:RETURN
13 POKE525-PV*367,9:BU=527+PV*96:FORI=BUTOBU+8:POKEI,13:NEXT:RETURN
14 PRINT"SYS62894QQQQQQQQ":PRINT"GOTO4]TTTTTTTTTTTTTT]":STOP
15 PRINT"SYS62886QQQQQQQQ":PRINT"GOTO4]TTTTTTTTTTTTTT]":STOP
16 PRINT"SYS62949QQQQQQQQ":PRINT"GOTO4]TTTTTTTTTTTTTT]":STOP
17 GOSUB12:PRINT"QQQQQSYS62403":PRINT"]TTTTTTTTT]":STOP
18 GOSUB12:PRINT"QQQQQSYS62393QQQ":PRINT"GOTO19]TTTTTTTTTTTT]":STOP
19 SYS50242
20 SYS828
21 POKE42,PEEK(826)+2:POKE44,PEEK(826)+2:POKE46,PEEK(826)+2
22 POKE43,PEEK(827):POKE45,PEEK(827):POKE47,PEEK(827):END
23 GOSUB12:PRINT"QQQQQSYS62456QQQ":PRINT"GOTO24]TTTTTTTTTTTT]":STOP
24 SYS46262
25 SYS828
26 GOTO21
27 PRINT"QRERROR.■  TAPE TO BE APPENDED IS NOT A     SIMPLE BASIC PROGRAM."
28 PRINT"MACHINE-LANGUAGE SEGMENTS MUST BE SAVED SEPARATELY.":END
29 PRINT"QRERROR.■  NOT ENOUGH MEMORY SPACE LEFT TO APPEND THIS PROGRAM.":END
```

Figure 2. BASIC Program Listing

APPEND Program running on	Tape SAVEd by
Version 1 PET (BASIC 2.0)	Version 1 PET Version 2 PET/CBM 8000 Series CBM
Version 2 PET/CBM (BASIC 3.0)	Version 1 PET Version 2 PET/CBM 8000 Series CBM
8000 Series CBM (BASIC 4.0)	Version 1 PET Version 2 PET/CBM 8000 Series CBM

Figure 3

BASIC 2.0	BASIC 3.0	BASIC 4.0	Routine
SYS 62894	SYS 62886	SYS 62949	Find program header
SYS 62403	SYS 62393	SYS 62456	Load program
*	SYS 50242	SYS 46262	Fix chaining of program link pointers

*done automatically by BASIC 2.0 "load program" routine

Figure 4. Differences in Built-in Routines

One other difference is that on BASIC 3.0 & 4.0 machines, it is necessary to reset the pointers for variable storage to the new end-of-program. This fix, too, was done by the "Load program" routine on BASIC 2.0 machines.

Alignment

More subtle is the problem of properly aligning the appended program to the one already in the computer. Version 1 PETs start the SAVE process at location 1024 (0400 in hexadecimal notation), which fortunately always contains a zero. BASIC 3.0 & 4.0 PET/CBM computers, on the other hand, start SAVEing at location 1025 (hexadecimal 0401).

At the end of each line of BASIC program text, there is one byte which contains a value of zero to mark the place (not the same as the ASCII character zero, which is stored as a value of 48). Following each of these line-end markers, except the last one, are two bytes containing a line pointer, then two bytes containing the value of the program line number. The last line-end marker is followed by two zero-value bytes, so this series of three zero-bytes may be thought of as an end-of-program marker. Figure 5 illustrates this scheme.

```
1024  1025
 | 0 | text | 0 | text | 0 | text | 0 | 0 | 0 |
                                  end of program
```

Figure 5

Focusing in on the end-of-program area, Figure 6 shows how each of the two types of SAVEd program must be lined up with the program in the machine, if a successful APPEND is to occur. Notice that the leading byte of the BASIC 2.0 tape (which is always zero since it originated in byte 1024) can be overlaid on the last end-of-line marker, since both values are zero. All we have to do, then, is detect whether the

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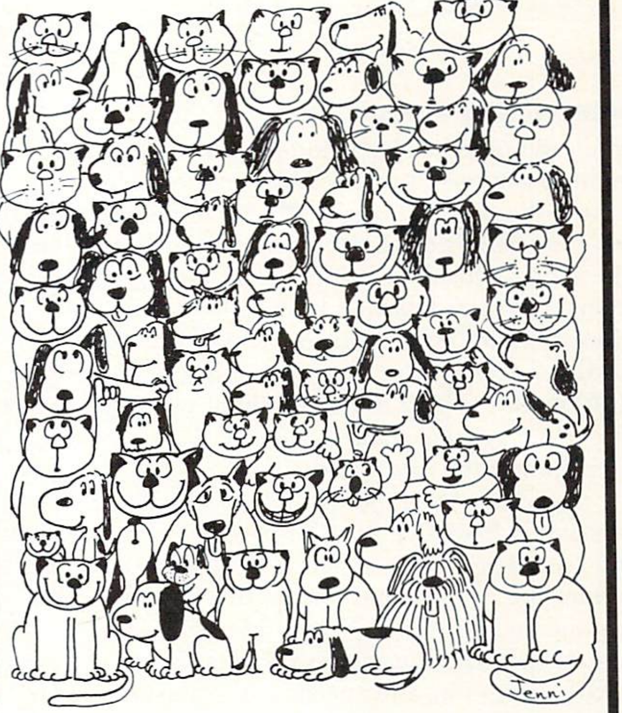

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program was SAVEd on a BASIC 2.0 or BASIC 3.0/4.0 machine, and adjust the location for starting the LOAD, if necessary.

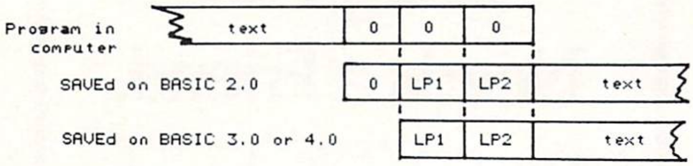

Figure 6

Determining Source

When the tape header is found, the starting and ending locations of the SAVE operation which created the tape are retrieved and stored in decimal locations 635 through 638 (hexadecimal 027B-027E). The starting location is in the first two bytes (low order byte first, followed by high), and the ending address is the last two. If the SAVE was done by a BASIC 2.0 computer, then the starting address in location 1024 (0400 in hexadecimal notation), which 636 would contain values of 1 and 4 respectively, after the header was found.

Byte 635, then, holds the key. A value of zero indicates a BASIC 2.0 SAVE, while a value of one indicates BASIC 3.0 or 4.0. The test for this value is in lines 4-6 of the program, Figure 2. If byte 635 contains neither 0 nor 1, or if byte 636 contains other than 4, then the routine on the tape is not a 'normal' BASIC program, and special steps must be taken before it can be appended.

Entering the Program

While the BASIC portion of the program may be typed in quite simply, the easiest way to enter the machine language segment is to use the monitor, so it is a good idea to do that part first.

If you are using a BASIC 2.0 PET, it will be necessary to load the monitor from tape, then tell it to RUN. On the newer 2001 series computers, simply enter SYS 64785. On the 8000 series, enter SYS 54386. Either machine will then give a display of register contents, similar to that at the top of Figure 1, a dot at the beginning of the current line, and the cursor just after the dot.

Simply type in the locations and contents as they are shown in Figure 1, ending each line with a carriage return. When you are finished, type

M 033A 0377

and press 'RETURN', and your entries will be displayed so you can check them. Should any mistakes be found, simply move the cursor to the appropriate location, type in the correct value, and press 'RETURN' to correct them.

When you are satisfied that the program has been entered correctly, enter X, and the monitor will transfer control back to the BASIC operating system.

Before you start typing in the BASIC part of the program, if you are using a BASIC 2.0 PET, be sure to type NEW to clear out the monitor.

Saving the Program

When both programs have been entered, be sure to SAVE a copy (or two) for security, to avoid the embarrassment of discovering a machine language error by losing control of the computer.

In BASIC 3.0 enter SYS 64785, or in BASIC 4.0 use SYS 54386, to return to the monitor. Then enter

S "APPEND", 01, 033A, 08BA

You will get the standard "Press Play and Record" messages. When you're finished, enter X to return to BASIC.

On Version 1 machines, enter

POKE 247,58:POKE 248,3:POKE 229, 186:POKE 230,8

then enter SYS 63153. A second copy may be saved by simply entering SYS 63153 again.

Testing

To see if the program works correctly, first LOAD one of the copies you have just made (if you've done any SAVE or VERIFY, you'll always have to do another LOAD to make the program work correctly.

Then remove the APPEND tape from the cassette unit, insert a tape on which another program

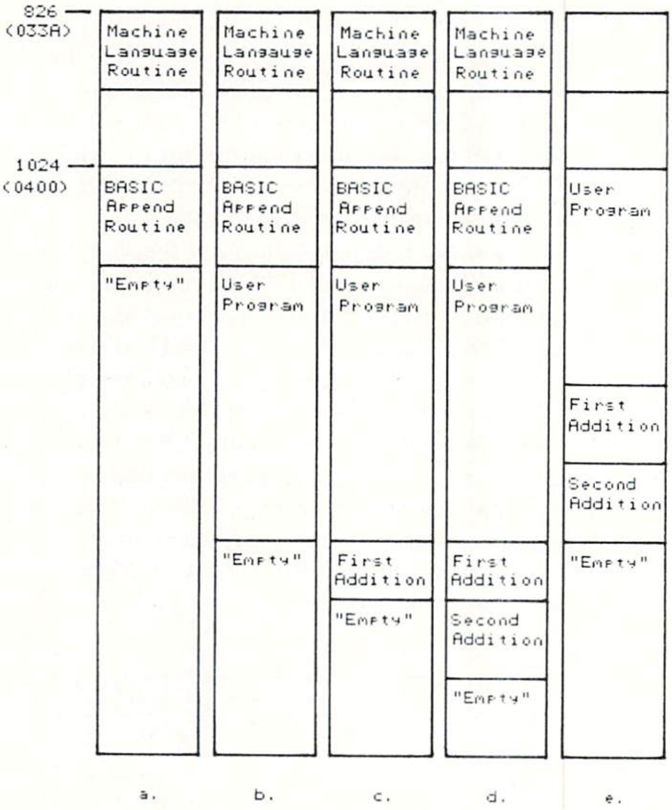

Figure 7. Allocation of Memory during Append Operations

a. At beginning of process, append program loaded
b. After User Program has been appended
c. After first addition to User Program
d. After second addition to User Program
e. End of process, after append routine is deleted

has been stored, and enter RUN. After the cassette unit stops and the computer reports READY, you should be able to enter LIST and see the append program followed by the one you just added to it.

If you have to make corrections to the BASIC program, do so in the usual manner, but be sure to use the special SAVE instructions described earlier. If you need to make machine language corrections, then enter the monitor, make the corrections, and save as specified.

Machine language corrections on Version 1 are more complicated, but are not too difficult if you're careful.

1. LOAD the APPEND program
2. On a separate tape, use the regular BASIC SAVE to create a copy of the BASIC portion only
3. LOAD the monitor
4. Make the necessary corrections
5. LOAD the BASIC portion made in step 2
6. Use the modified SAVE procedures (POKE, SYS) to save the combined program.

If a "high" (relocated) Monitor is used, steps 2 and 5 may be avoided, but this is recommended only for those who are confident of their ability to do it properly.

Experimenting

If you understand how the program operates, it's possible to reduce the size of the program somewhat, but be careful and test your condensed program on tapes that are not valuable. We intentionally left it longer for the article so it would be easier to understand. If you only need to use the program on one type of computer, you should not have great difficulty in trimming out the unecessary parts.

Credits

Thanks are due to Jim Butterfield, whose discovery and publicizing of PET/CBM ROM details made possible the program described in this article; and also to Jack O'Neil and Mike Johnson, whose patient attempts to use the program in earlier stages were of great assistance in refining it.

Readers with comments or observations on operation of the routines are invited to send them to me at Virginia Micro Systems, Inc., 14415 Jefferson Davis Highway, Woodbridge VA 22191. ©

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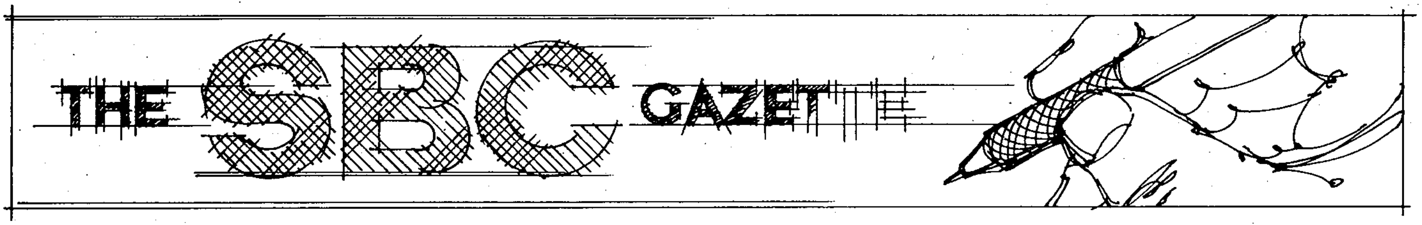

Nuts and Volts

Gene Zumchak

In my last N&V column (Nov/Dec), I talked about parallel interfacing techniques, and intended to talk about serial techniques in my next column. Before that column reached print, however, Eric Rehnke, quite independently, wrote up the same subject for his January column. Until I read Eric's column, I actually thought I had covered the topic. Shame on me. Between our two columns, I think we have probably raised more questions than we have answered. Since Eric at least provided a pair of programs, his treatment was certainly more complete. So with a little egg on my face, I'm going to take another shot at handshaking.

Handshaking is a scheme by which data can be transferred between two asynchronous systems (1) without error and (2) at the fastest possible rate. While number one is always a requirement, two may not be. Still, it is usually desirable to perform a handshaking transaction in the shortest possible time.

True handshaking requires that one flag each be asserted by the sender and receiver. The nature, polarity, and names of these flags are not standard, and a large number of variations are possible. Typical names for the flag asserted by the sender are **DATA READY, DATA AVAILABLE,** and **DATA VALID.** The flag asserted by the receiver is sometimes called **BUSY, DATA TAKEN,** or **ACK**nowledge. When looking at an already defined handshake sequence, be sure to note whether flags are high-true (active-high) or low-true.

The handshaking signals most likely to be encountered by a computer user are those used with a parallel printer, often called "Centronics" handshaking. Eric stated in his article that he "decided to simplify it (the "Centronics" handshaking signals are shown in Figure 1. Note, that although there are three handshaking lines, this is NOT a three-wire handshake. The line asserted by the sender is a pulse called **DATA STROBE** (usually low-true). The receiver (printer) responds by raising a **BUSY** flag (usually high-true). Alternatively, the sender can choose not to use the **BUSY** flag, but instead use a third flag called **ACK,** which is a low-true pulse which occurs at the trailing edge of **BUSY,** indicating that the printer is no longer **BUSY** and can accept characters again. The two flags from the printer are provided as a convenience. They convey the same information and only one or the other need be used. Consequently, the so-called "Centronics" handshake is indeed a two-wire handshake. Traditionally, the level signal **(BUSY)** is used when handshaking is serviced using polling. The pulse signal **(ACK)** is used to set an interrupt flip-flop, when interrupt servicing is used. (If there are more than one receiving devices, a two-wire handshake will not suffice. A three-wire handshake, invented (and patented) by Hewlett Packard, is used on the IEEE-488 GPIB to accommodate multiple receivers. This bus will be discussed in a future column).

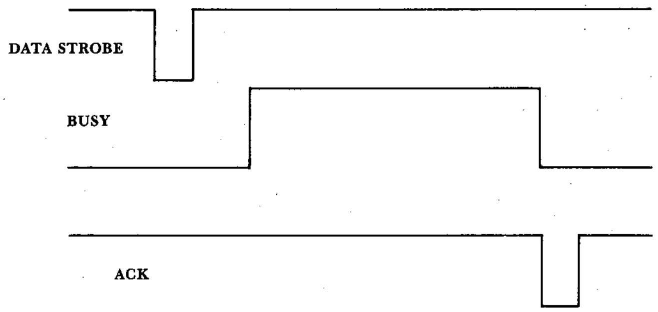

Figure 1. "Centronics" Printer Handshaking

A very typical handshake sequence is shown in Figure 2. The flag asserted by the sender is a low-true **DATA READY**. The flag returned by the receiver is called **BUSY** and is high-true. The sequence is as follows:

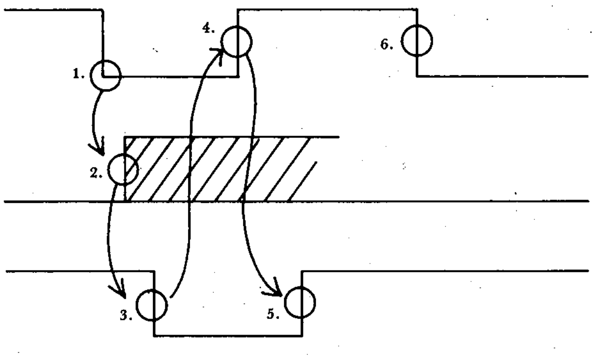

Figure 2. Typical Handshake Sequence

1. Sender polls **BUSY** and waits for **BUSY** to become false (not busy).
2. Sender places data on the data lines.
3. Sender asserts **DATA READY.**

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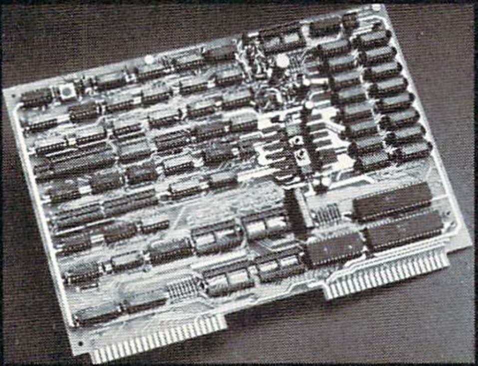

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4. Receiver acknowledges receipt of data by raising its **BUSY** flag.

5. Sender removes (raises) **DATA READY.**

6. Receiver lowers **BUSY** when ready for new data.

This sequence can be seen to be equivalent to that suggested by Eric, except that his **DATA READY** is a high-true signal. The choice of signal polarity given here is consistent with the operation of programmable port chips. I/O pins on such chips come up from reset as inputs and are high. Thus the **DATA READY** naturally comes up in the false state. For the receiver, the **BUSY** comes up naturally high, so that no sequence can be started until the receiver program is started and its **BUSY** line is cleared. It will not matter, therefore, whether the receive program or the send program is started first.

Just as the data direction registers come up zeroes from reset defining inputs, the data registers come up zeroes as well. Therefore, it is a good idea to write output data to port bits *BEFORE* configuring the bits as outputs. If the port bits are made outputs first, they will immediately fall to zero, since the reset line zeroes the data register. Even if the program immediately writes ones to the outputs, all output lines will experience a momentary glitch to ground (for the duration of an instruction) until the new data is written. It is important to understand that data can always be written to ports as outputs, even if they are programmed as inputs. Making a bit an input bit merely disconnects the flip-flop from the I/O pin. Even though you will not be able to read the data that you have written to an output bit, it is still in the flip-flop. A representation of a programmable port I/O bit (PAO) and the corresponding data direction register bit is shown in Figure 3, and is worth discussing.

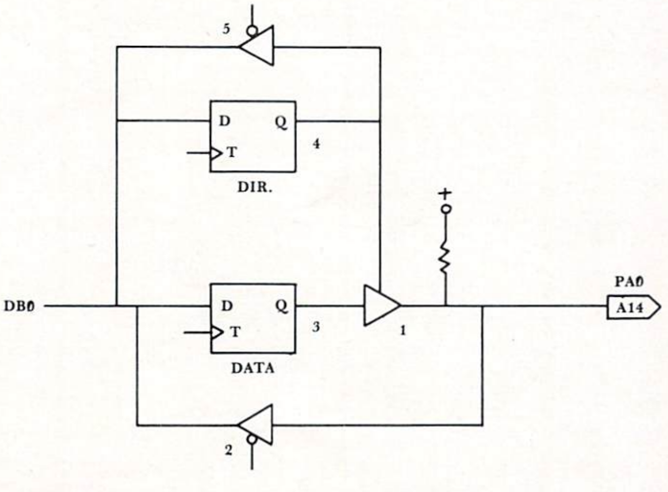

Figure 3. Programmable Port Structure

The flip-flop (item 3) has its "D" input connected to the data bus bit DBO. It can serve as an output bit if and only if it is connected to the port pin PAO via the three-state gate (item 1). With this gate enabled, anything written to the zero bit of a port A will appear on the I/O pin. If the gate is disabled, however, we are now free to use the I/O pin as an input. Note, however, that programming the bit as an input *DOES NOT* PREVENT US FROM WRITING TO THE **DATA** flip-flop. While we will not be able to read the data back, the data is still in the flip-flop, and it will appear on the I/O pin if this bit is subsequently made an output. When the port is read it is the condition of the I/O pin that is being read, regardless of whether the bit is programmed as an input or output. (This is not true of B ports, where the data read back when programmed is the latched data. That is, a bit can be programmed as an output and a one and the I/O pin shorted to ground and have it read back as a one). The three-state gate (item 1) is controlled by a second flip-flop (item 4) called a data direction flip-flop. This condition of this flip-flop may be read via its three-state gate (item 5). (Note that what we have called a three-state gate is in actuality implemented with MOS open-drain technology).

The purpose of this discussion was to convince the reader, that it is possible to successfully write output data to a port while it is still programmed as input. Not only is it possible, but it is recommended as good port software technique, to avoid unnecessary output "glitches".

Getting back to handshaking, it is now necessary to look at handshaking software. We would like to consider both the transmit and receive programs. Figure 4 shows a flowchart for a transmit program. First the ports must be set up. Then before transmitting, we must be certain that the receiver is not **BUSY,** and wait until **BUSY** is false. Then data is loaded and sent to the port. Next the **DATA READY** flag is lowered. The program now waits for the handshake response from the receiver, that is, for **BUSY** to become true. As soon as that has been verified, the **DATA READY** flag is cleared and the memory pointer is incremented and compared with the end pointer. If the end has not been reached, the process is repeated for another byte. Otherwise the program returns to the monitor.

A flowchart for a receive program is shown in Figure 5. After initialization, a wait is made for a **DATA READY** indication, then the data is tucked away, the **BUSY** flag raised, and the pointer incremented. At this point, the pointer may be compared with an endpoint for a completion test. If done, the **BUSY** flag is lowered and a return made to the monitor. If not, the **BUSY** flag is lowered and another data byte is fetched.

Both transmit and receive programs can vary, depending upon whether speed or code conciseness is the most desirable feature. This discussion will be continued in the next column with an analysis of typical transmit and receive programs.

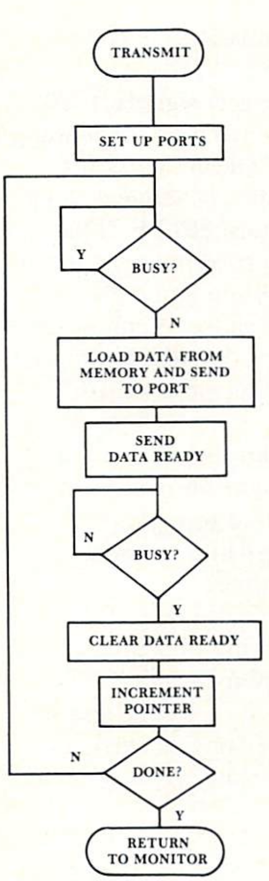

Figure 4. Transmit Handshake Flowchart

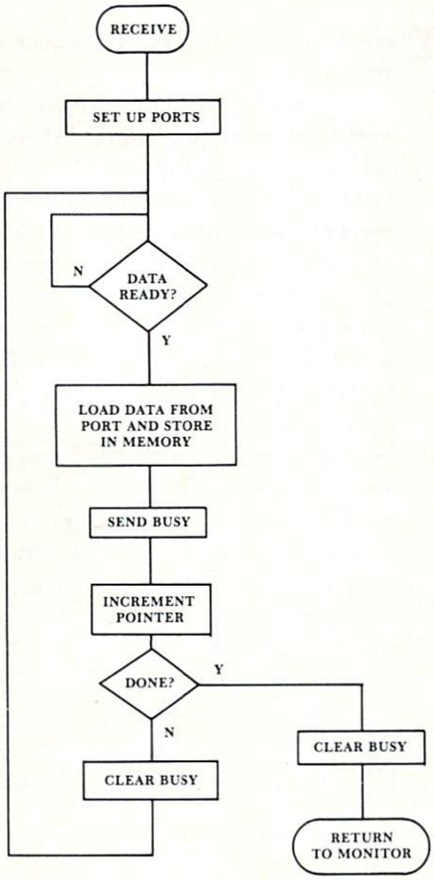

Figure 5. Receive Handshake Flowchart

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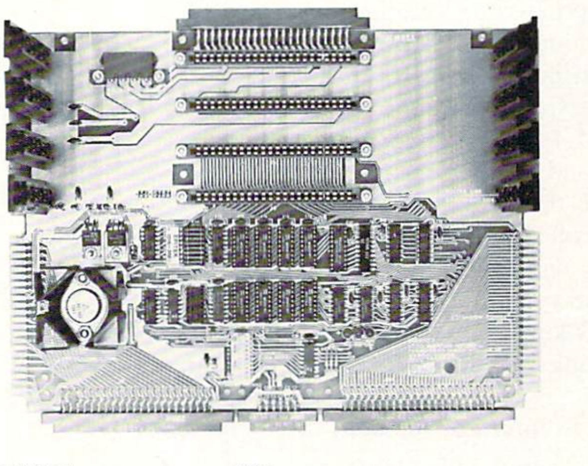

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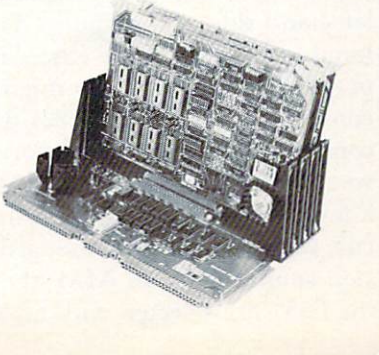

Experimenting With The 6551 ACIA

Marvin L. De Jong
Department of Mathematics-Physics
The School of the Ozarks
Pt. Lookout, MO

There is a growing interest in data communications, computer networks, time-sharing services and other forms of intercomputer communications. An important element in many data communications systems is an Asynchronous Communications Interface Adapter (ACIA). Both Rockwell International and Synertek manufacture a 6502 family device known as the 6551 ACIA. The purpose of this article is to provide information about interfacing this device to 6502-based microcomputers and to provide information about operating and controlling the 6551 with software.

Since I was not familiar with this chip, I decided to do some simple experiments with it to supplement the meager (in my opinion) information supplied by the specification sheets from Rockwell and Synertek. In particular, I decided to use my AIM 65 microcomputer as a smart terminal for a KIM-1, operating the latter in its "teletypewriter" mode. Although this may seem ridiculous, the idea might be useful in a laboratory where various student stations have a KIM-1 that is used for experiment control or data acquisition. If all the KIM-1s were connected to a central terminal, one could load a program into all of them simultaneously or, with the appropriate switching circuitry, one could collect and process data from each of them. In any case, the experiment taught me what a KIM-1 is like when operated in its TTY mode rather than from its keypad, and more importantly, I learned some things about the 6551 ACIA.

A circuit that can be used to interface the 6551 to a 6502-based microcomputer is shown in Figure 1. The connections to the microcomputer are on the left-hand side of the figure. The advantage of using a family-type chip is the ease with which the device may be interfaced to the microcomputer. Thus, the connections IRQ, RES, Ø2, R/W, and the data bus connections are all straightforward. If the lines between the microcomputer and the 6551 are kept short, a few inches or so, no buffering is required. This circuit was built on a protoboard attached to the expansion connector of an AIM 65. The four registers on the 6551 are selected with address lines AØ and A1 connected to the register select pins RSØ and RS1, respectively.

The chip select (or device select) signals, CSØ and $\overline{\text{CS1}}$, can be obtained in several ways depending on your microcomputer system. The AIM 65 provides a $\overline{\text{DS9}}$ device select pulse that is active at logic zero for all addresses \$9000 through \$9FFF. This signal is available at the expansion connector, and it was used in this circuit. The CSØ pin could have been connected to +5V, but we chose to connect it to address line A1Ø to save half of the address space between \$9000 and \$9FFF for other possible I/O functions.

If you have a SYM-1 you can use device select $\overline{\text{18}}$, which is available on the expansion connector, for $\overline{\text{CS1}}$. Pin CSØ can either be tied to logic one (+5V) or connected to an address line to divide the device select $\overline{\text{18}}$ address space in half.

If you have a KIM-1 you can use one of the device selects K1 to K4 with suitable pull-up resistors, say 1000 ohms. Tie CSØ to +5V.

If you have an APPLE II you can build the interface shown in Figure 1 on a peripheral card and plug it into one of the eight card slots. However, you

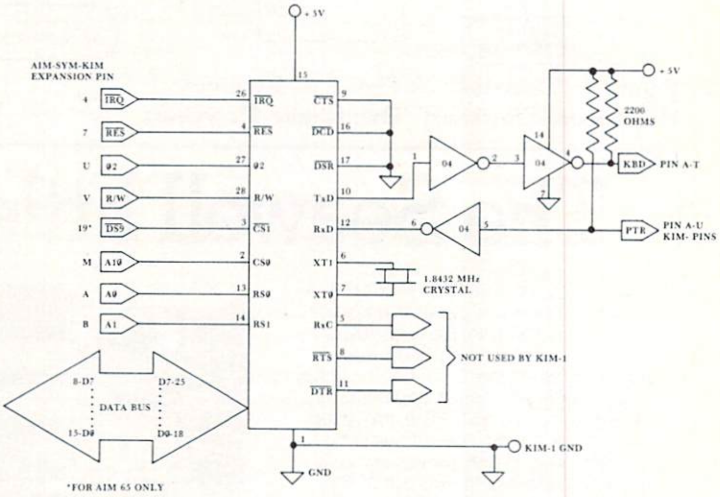

Figure 1. The circuit to interface the 6551 ACIA to a 6502-based microcomputer to control a KIM-1.

must build your own decoding circuit because you cannot use either the device select ($\overline{\text{DS}}$) or the I/O select signals. 6502 family chips such as the 6522 and the 6551 generally require that the address lines and the chip selects are stable some time (approximately 200 nanoseconds) before the rising edge of the Ø2 clock signal. The device select signals generated by the APPLE II address decoding circuitry have been ANDED with Ø2 (actually ØØ), and consequently they cannot be used. This is really unfortunate since it would be very easy to interface 6502 family chips to the APPLE's peripheral bus if it were not for this fact. One could use a 74LS04 inverter and a 74LS30 eight input NAND gate to generate a device select for some page of memory not used by the APPLE II, if you want to interface a 6551 to your APPLE II.

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Proceeding to the circuitry on the right-hand side of Figure 1, you will note that you need a crystal whose frequency is 1.8432 MHz. The remaining connections are either input or output pins that connect the 6551 to devices outside of the microcomputer system, such as a modem or, in the experiment described here, another microcomputer. In this application only the data output (TxD) and data input (RxD) pins were used. A 74LS04 was used to provide suitable buffering between the 6551 and the KIM-1 printer and keyboard pins for the teletypewriter. The input pins $\overline{CTS}$, $\overline{DCD}$, and $\overline{DSR}$ are tied to logic zero while the output pins $\overline{RTS}$ and $\overline{DTR}$ are left floating in this application. If the 6551 were connected to a modem, printer, or another terminal, then these pins would be used. The similarity between the names of these pins and RS-232C pin functions is not a coincidence. My modem requires the $\overline{CTS}$, $\overline{DSR}$, and $\overline{DCD}$ connections. A 1488 RS-232C line driver and a 1489 RS-232C line receiver could be used to change the voltages to the appropriate levels for a standard RS-232C interface, but we chose to experiment with a KIM-1, and did not need RS-232C signals.

If A0 and A1 are used as register select signals, as indicated in Figure 1, then the low-order nibble of the address that accesses the 6551 will be $0, $1, $2, and $3 for the data registers, status register, command register, and control register, respectively. For example, if the address decoding scheme shown in Figure 1 is used, the transmitter data register is accessed by WRITING to $9400 and the receiver data register is accessed by READING location $9400. Writing to the status register at $9401 causes a programmed RESET, and the status register is read at $9401. Refer to Figure 2 to identify the meaning of the bits in the status register.

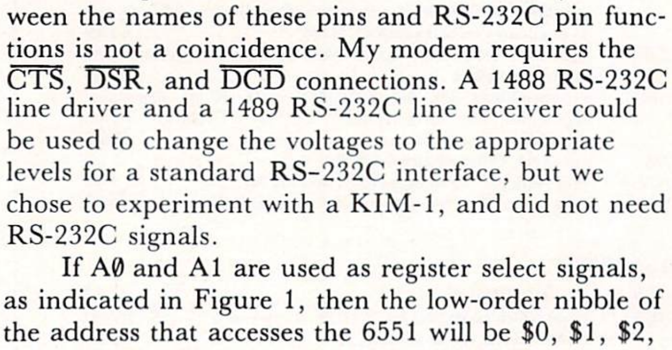

Figure 2. Schematic diagram of the status register of the 6551.

For the simple experiments described here the status register bits of most interest are the **transmitter register flag** and the **receiver register flag.** Writing to the transmitter register clears the register flag, and one should not write data to this register again until the data in the transmitter register has been transformed into a serial bit stream and has been transmitted by way of the TxD pin. When the word has been transmitted, bit four goes to logic one, and the transmitter data register is ready to accept another word. Likewise, when a complete word has been received by way of the RxD pin and the word is in the receiver data register, then bit three of the status register goes to logic one, and the word is ready to be read from the 6551. Both of the events just described may be used to produce interrupt requests ($\overline{IRQ}$ pin goes to logic zero). That is, by programming the command register, one can produce an interrupt request either when the transmitter register is empty or when the receiver register is full.

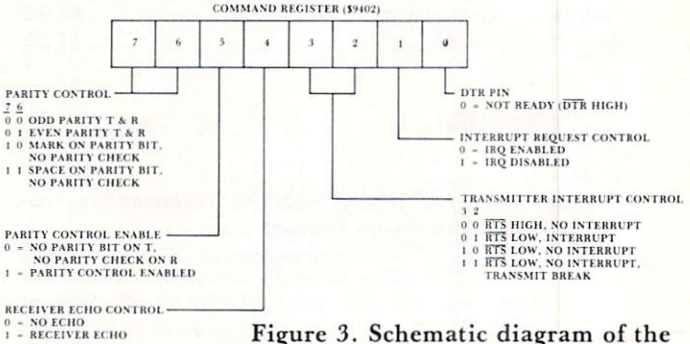

Figure 3. Schematic diagram of the command register of the 6551.

Refer to Figure 3 to identify the meaning of the various bits in the command register, and refer to Figure 4 to identify the meaning of the bits in the control register. The function of these registers will become apparent when we describe the program to use the AIM 65 as a terminal to control the KIM-1. In short, they allow the user to program the 6551 to operate under a large variety of conditions.

The program to test the 6551 with the AIM 65 and KIM-1 is given in Listing 1. The main program reads the keyboard and outputs this character to the 6551 transmit data register. The interrupt routine (remember to load the interrupt vectors if you use this program) reads the 6551 receive data register when the KIM-1 returns information to the AIM 65. In short, the entire program makes the AIM 65 behave exactly like a teletypewriter terminal as far as the KIM-1 is concerned. Since the 6551 is being operated in the interrupt mode, the first instruction in Listing 1 clears the 6502 interrupt flag to allow the 6551 to interrupt it. The next two instructions in the program load the command register. Refer to Figure 3 to see what bits were set or cleared. Since the KIM-1 software in the monitor simply strips the parity bit from any received word, the command register was initialized to disable and disregard any parity bits. Since the 6551 is being operated in an interrupt mode, bit one of the command register is cleared. However, it is the receiver portion of the 6551 that is being allowed to cause an interrupt, thus bit three of the command register is kept at logic one to prevent interrupts from the transmitter. The other bits of the command register control the handshaking signal pins of the 6551, and therefore they were not of any concern in this application.

The fourth and fifth instructions in Listing 1

load the control register. Refer to Figure 4. A "three" in the low-order nibble of the control

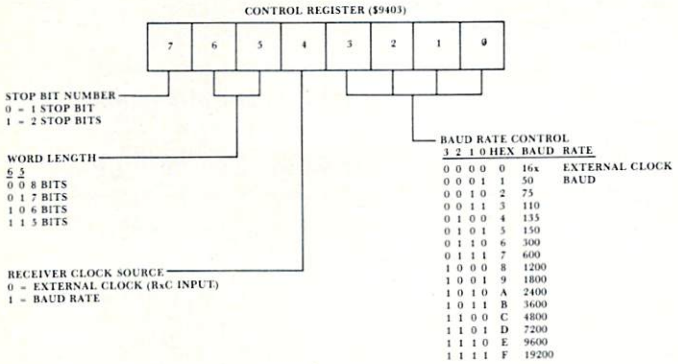

Figure 4. Schematic diagram of the control register of the 6551.

register sets the Baud rate at 110. Higher Baud rates are possible, depending in part on whether the thermal printer on the AIM 65 is used. Without the printer operating, rates as high as 2400 Baud are possible. The usual teletypewriter data format is one start bit, seven data bits, one parity bit, and two stop bits. However, a number of formats will work, and we chose an eight bit word with one stop bit. Note however that the command register was set up for no parity bit, thus our word looks just like a word in the teletypewriter format. If we would have loaded the control register with $BA sending seven bits of word and two stop bits at 2400 Baud, the program would still work. In order to interface the 6551 to any device you must program the command and control registers to match the *protocol* of the devices that are communicating.

Still keeping an eye on Listing 1, note that the next instruction is a subroutine jump to an AIM 65 subroutine that reads the keyboard and returns the ASCII code for the key depressed in the 6502 accumulator. This character is loaded into the 6551 transmit data register, and is promptly sent out on the TxD pin in serial form. Before getting another character, the program waits in a loop until the word is sent. It does this by examining bit four in the status register (refer to Figure 2). When the character has been sent and the transmit data register is empty, then the program loops back to get another character when the keyboard is scanned.

Refer next to the interrupt routine. A PHA instruction saves the accumulator. Next, the receive data register is read. The only time an interrupt occurs is when a new word is received from the KIM-1, and the second instruction of the interrupt routine gets the character in the accumulator of the AIM 65's 6502. Next, it outputs the character to the AIM 65 display. The fourth instruction clears the interrupt signal from the 6551. The accumulator is recalled, and the interrupt routine is concluded.

A future project includes interfacing the 6551 to a Novation Cat modem and trying to send information over telephone lines. Anyone out there care to join this experiment?

Listing 1. Routines to Control the KIM-1 with an AIM 65.

```
CTRLRG  = $9403; Control register of the 6551.
CMNDRG  = $9402; Command register of the 6551.
STATUS  = $9401; Status register of the 6551.
RDWR    = $9400; Read/Write Data register of the 6551.
$0F00 58        START    CLI              Clear interrupt flag.
 0F01 A9 09              LDA #$09         Set up command register.
 0F03 8D 02 94           STA CMNDRG
 0F06 A9 13              LDA #$13         Set up control register.
 0F08 8D 03 94           STA CTRLRG       Baud rate is 110.
 0F0B 20 3C E9  REPEAT   JSR GETKEY       Get input character from the
 0F0E 8D 00 94           STA RDWR         AIM 65 keyboard, output it to
                                          6551.
 0F11 AD 01 94  CHECK    LDA STATUS       Is transmit register empty?
 0F14 29 10              AND #$10
 0F16 F0 F9              BEQ CHECK        No. Then wait here.
 0F18 D0 F1              BNE REPEAT       Yes. Then get another character.

Interrupt Routine
$0E00 48        IRQ      PHA              Save accumulator.
 0E01 AD 00 94           LDA RDWR         Read the receive register and
 0E04 20 7A E9           JSR OUTCHAR      output the result.
 0E07 AD 01 94           LDA STATUS       Read the status register to clear
 0E0A 68                 PLA              the interrupt flag.
 0E0B 40                 RTI              Return to the main program.
INTERRUPT VECTORS: [$A404] = $00; [$A405] = $0E
```

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A Vocal Hex Dump For The KIM-1

William C. Clements, Jr.
Dept. Of Chemical And
Metallurgical Engineering
The University Of Alabama

This article describes a program for the KIM-1 that begins at a given RAM address and pronounces the contents of successive locations, with appropriate pauses inserted for naturalness, just as a person would read off a list of hex words. It uses what is almost certainly the least expensive speech synthesis equipment and software now on the market; for about $100, the single-board computer owner can experiment with computer-generated speech. The program given here is concerned with removing a little of the drudgery from proofreading programs in RAM. The program runs on a KIM-1 to which has been added a 6522 VIA and at least 1K of expansion RAM.

Personal computers surely are the ultimate in modern versatility, making everything from dungeons-and-dragons to home automation to self-instruction in computer science available to nearly everyone. But no matter how much fun it is to use the polished end result of one's programming, the checking of machine code to see if it was entered correctly remains pure drudgery, and the cleverest technology isn't likely to ever place it on a level with playing a rousing game of motorcycle racing with the computer. For those of us with video terminals but no printer, it can be especially irritating; one's eyes move up to the screen dump, down to the written program, up and down, kind of like watching a vertical tennis game, until the eyes have had it.

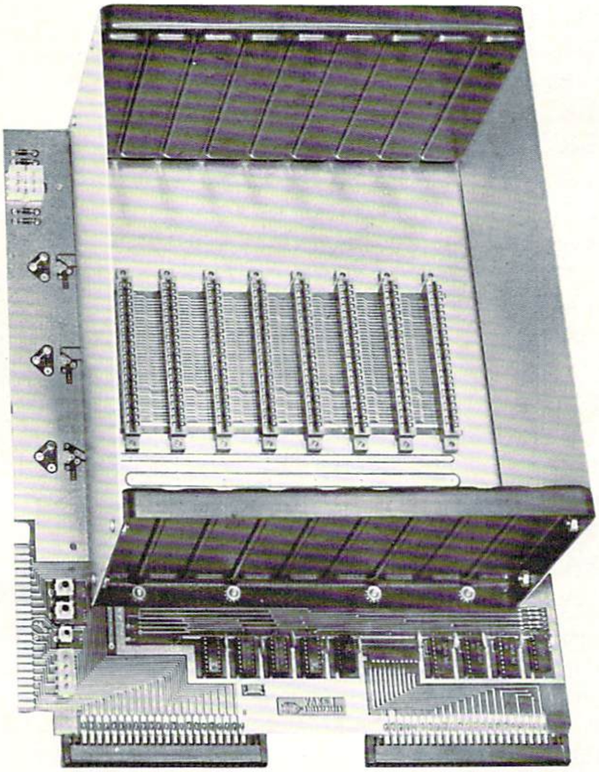
It would help to have someone read off the code from the screen so the programmer can keep his eyes on the paper. But another person isn't always available, and anyhow this is just the kind of work that computers were invented to handle, right? The only trouble is, most speech synthesizers are expensive, and are usually for the S-100 bus, not directly usable with the KIM or similar single-board machine. Now, thanks to Texas Instruments, Inc. and Dave Kemp of East Coast Micro Products, these objections have been neatly removed. The T-I Speak and Spell™, an inexpensive ($50 range) preprogrammed speech synthesizer computer was developed to teach kids to spell.[1] Its internal ROMs contain the coding to vocalize hundreds of words plus several phrases, the letters of the alphabet, and the numerals. But it's more than a toy. The device has an internal edge connector intended for plugging in additional vocabulary ROMs, and the various control lines that operate the speech synthesizer are available there. East Coast Micro Products market a small interface kit, model SP-1[1], that plugs onto the edge connector, and performs the level shifting and parallel-to-serial conversion needed for interfacing the synthesizer to a computer. The whole thing fits into the battery compartment of the Speak and Spell™, making a very neat package. Along with the interface board, you get extensive support software, a detailed explanation of how the synthesizer works, and five demo programs written for the SYM computer. The software includes a program for pronouncing individual hex characters whose ASCII representation has been placed in the accumulator, and uses the 6522 VIA that the SYM uses for I/0.

As mentioned at the start of this article, my immediate goal in purchasing the SP-1 was to use it with a KIM to read out memory words. The listing gives the resulting program. The user begins execution at BEGIN, types the first RAM address on the TTY, and the program reads 256 locations out on the Speak and Spell™. If you're checking fewer locations, just hit the reset key when you're through. If your program is longer, type in the next location and it will read you 256 more.

The comments in the listing should be self explanatory for the most part. Label references not defined in the listing (such as FPNT, OUTSPE, etc.) are mostly labels in the SP-1 software. GETBYT is a routine in the KIM monitor.

The SP-1 software is set up to use the 6522 Versatile Interface Adaptor on the SYM board, so unless you want to re-program extensively, your best bet is to add a 6522 to your KIM; you ought to have one anyhow if you're a serious KIMmer. Mine was already present on a VIDEO PLUS™ board that I use with my system[1]. If you don't have a VIA in your system, I suggest you refer to the articles listed in the footnotes[3,4]. It should not be hard to provide one. The SP-1 software resides entirely in the KIM on-board memory with one exception: the speech data dictionary provided with the software requires 770 bytes of continuous memory in addition to the 478 bytes required by the SP-1 support software and by the vocal dump routine. None of the code is self-modifying, so you can relocate it at will, even into EPROM where it will become a valuable utility. The only memory that has to be RAM is the twelve-byte frame buffer which I located between $17A0 and $17AB. If you do relocate, take care to adjust the entries in TABLE. These are address pointers to entries in the speech dictionary supplied with the SP-1. The accompanying program listing assumes that the dictionary resides between $2000 and $2302 in expansion memory.

VAK-1 MOTHERBOARD



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                  0030 ADHI      .DE $B
                  0035 SPNT      .DE 2
                  0040 GETBYT    .DE $1F9D
                  0050 FPNT      .DE 4
                  0060 SPINIT    .DE $200
                  0070 OUTSPE    .DE $2D0
0100- 20 9D 1F    0080 BEGIN     JSR GETBYT     ;GET START
0103- 85 0B       0090           STA *ADHI      ;ADDRESS
0105- 20 9D 1F    0100           JSR GETBYT     ;FROM
0108- 85 0A       0110           STA *ADLO      ;KEYBOARD
010A- A9 A0       0120           LDA #$A0       ;SET FRAME
010C- 85 04       0130           STA *FPNT      ;POINTER
010E- A9 17       0140           LDA #$17       ;TO
0110- 85 05       0150           STA *FPNT+1    ;$17A0 (12 LOCS NEEDED)
0112- 20 00 02    0160           JSR SPINIT     ;SET UP TIMERS
0115- 20 2D 01    0170           JSR PAUSE      ;PAUSE BEFORE SPEAKING
0118- A0 FF       0180           LDY #$FF       ;USE Y TO COUNT LOCS.
011A- C8          0190 LOOP      INY            ;DUMPED
011B- 98          0200           TYA
011C- 48          0210           PHA
011D- B1 0A       0220           LDA (ADLO),Y   ;GET CURRENT CONTENTS FOR DUMP
011F- 20 31 01    0230           JSR SAY        ;PRONOUNCE CONTENTS;
0122- 20 2D 01    0240           JSR PAUSE      ;THEN PAUSE
0125- 68          0250           PLA
0126- A8          0260           TAY
0127- C9 FF       0270           CMP #$FF
0129- D0 EF       0280           BNE LOOP       ;LOOP 256 TIMES
012B- F0 D3       0290           BEQ BEGIN      ;GET NEW START
012D- A2 20       0300 PAUSE     LDX #$20       ;SET POINTER FOR PAUSE
012F- D0 0E       0310           BNE SP1        ;BRANCH TO SPEECH PAUSE
0131- 48          0320 SAY       PHA            ;SAVE CONTENTS
0132- 29 F0       0330           AND #$F0       ;GET HIGH-ORDER NYBBLE
0134- 4A          0340           LSR A          ;FORM INDEX
0135- 4A          0350           LSR A          ;INTO ADDRESS TABLE
0136- 4A          0360           LSR A
0137- 20 3E 01    0370           JSR SPEAK      ;SPEAK FIRST CHARACTER
013A- 68          0380           PLA
013B- 29 0F       0390           AND #$F        ;GET LOW-ORDER NYBBLE
013D- 0A          0400           ASL A          ;FORM INDEX
013E- AA          0410 SPEAK     TAX            ;AND FALL THROUGH
013F- BD 4C 01    0420 SP1       LDA TABLE,X    ;TO SPEAK IT
0142- 85 02       0430           STA *SPNT
0144- BD 4D 01    0440           LDA TABLE+1,X
0147- 85 03       0450           STA *SPNT+1
0149- 4C D0 02    0460           JMP OUTSPE
014C- 00 20 49    0470 TABLE     .BY 0 $20 $49 $20 $76 $20 $9F $20 ;ADDRESS
                                 TABLE FOR
014F- 20 76 20
0152- 9F 20
0154- DB 20 11    0480           .BY $DB $20 $11 $21 $52 $21 $86 $21 ;
                                 SPEECH DICTIONARY
0157- 21 52 21
015A- 86 21
015C- B7 21 DA    0490           .BY $B7 $21 $DA $21 $16 $22 $36 $22
015F- 21 16 22
0162- 36 22
0164- 61 22 8E    0500           .BY $61 $22 $8E $22 $B5 $22 $D0 $22 $FD $22
0167- 22 B5 22
```

The SP-1 utilities can be used for many other purposes. A great deal of information and some references concerned with speech synthesis using Linear Predictive Coding techniques are given in the literature supplied with the kit. With this material, you can make your KIM as talkative as you wish!

```
016A- D0 22 FD
016D- 22
                    0510                .EN


LABEL FILE:    [ / = EXTERNAL ]

/ADLO=000A     /ADHI=000B /SPNT=0002
/GETBYT=1F9D /FPNT=0004 /SPINIT=0200
/OUTSPE=02D0 BEGIN=0100 LOOP=011A
PAUSE=012D    SAY=0131    SPEAK=013E
SP1=013F       TABLE=014C
//0000,016E,016E
```

Footnotes

1. Speak and Spell is a trademark of Texas Instruments, Inc. VIDEO PLUS is a trademark of The Computerist, Inc.
2. East Coast Micro Products, 1307 Beltram Ct., Odenton, Md. 21113.
3. See **6502 User Notes**, No. 13, p. 16 for information about adding a 6522 I/O board.
4. See **MICRO**, No. 17, pp. 27-39 for a general description of the 6522.

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6502 FORTH

- 6502 FORTH is a complete programming system which contains an interpreter/compiler as well as an assembler and editor.
- 6502 FORTH runs on a KIM-1 with a serial terminal. (Terminal should be at least 64 chr. wide)
- All terminal I/O is funnelled through a jump table near the beginning of the software and can easily be changed to jump to user written I/O drivers.
- 6502 FORTH uses cassette for the system mass storage device
- Cassette read/write routines are built in (includes Hypertape).
- 92 op-words are built into the standard vocabulary.
- Excellent machine language interface.
- 6502 FORTH as user extensible.
- 6502 FORTH is a true implementation of forth according to the criteria set down by the forth interest group.
- Specialized vocabularies can be developed for specific applications.
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The Modified KIM Bus

Part 3 of 3

This leads us to a definition of the "Unbuffered Modified KIM Bus". KIM is part of the name since the bus is essentially what a KIM-1 single board computer presents on its expansion connector. "Modified" is part of the name because not all of the 44 signals on the expansion connector are actually part of the bus. Those signals that are part of the bus are common to the SYM and AIM computers as well as the KIM and thus any of these machines may be plugged into the bus without modification.

Figure 6 gives a signal listing for the bus. Signals marked with an * do not connect to the processor but do connect to all of the other boards in the system. Most of these have different specialized functions on the different processors anyway and are not generally useful in a bus oriented system. Note that RDY is one of the signals that is not bussed. All modern memories are quite fast enough to operate without wait states in 6502 systems and besides, the 6502 will not wait during write cycles anyway. The lines marked (Reserved) are intended for future uses such as memory bank switching signals, etc.

Note that although RAM R/W is listed as a signal (should go low during phase 2 of Write cycles), it should not be used by a bus interface board for general application. The reason is that an AIM-65 printed circuit error makes it go low during *read* cycles rather than write cycles like it should. In any case, one should be able to design any kind of bus interface board using just A0 - A15, D0 - D7, R/W, PHASE 2, interrupt, and power voltages. The additional lines are really just convenience signals.

Two of the signals are important only in KIM systems. DECODE ENABLE must go low whenever addresses between 0000 and 1FFF are on the bus in order to activate KIM's on-board memory. VECTOR FETCH must go low whenever addresses between FFFA and FFFF are on the bus in order for the reset/interrupt vectors stored in the KIM monitor ROM's to be active. Although it is probably best for the motherboard to generate these two signals, many expansion boards generate them anyway so that the bus motherboard can be omitted altogether in systems with just one expansion board.

Note that direct memory access is not supported by the Modified KIM Bus because the address lines from the 6502 cannot be disabled. An approach to DMA in those interfaces that need it, such as video displays and disk controllers, is to provide *two-port memory* on the interface board itself. The big advantage then is that DMA to or from the on-board memory can then proceed at very high speed without slowing the processor at all. A conventional DMA system, such as on S-100 systems, would stop the processor cold at data rates beyond a couple of hundred thousand bytes per second.

Although +5 volts regulated is available on the bus, it is often preferable to use unregulated +8 and an on-board regulator to provide +5 to the logic circuitry of expansion boards. Similarly, +16 unregulated is available for generating +12 power needed by many memory chips. When negative voltages are needed such as for EPROM's or analog circuitry, they may be easily generated from the positive unregulated voltages with a charge-pump circuit and then regulated with IC regulators. The primary advantages of on-board regulation are a smaller and less expensive central power supply and clean, well regulated power on the expansion board itself. The potential problem of additional heat dissipation on the expansion boards is nullified by the very low power consumption of modern LS IC's.

PIN	KIM-1	SYM-1	AIM-65	MODIFIED
E-1	SYNC	SYNC	SYNC	SYNC
E-2	RDY	RDY	RDY	(reserved)
E-3	PHASE 1	PHASE 1	PHASE 1	(reserved)
E-4	IRQ	IRQ	IRQ	IRQ
E-5	SET OVERFLOW	SET OVERFLOW	SET OVERFLOW	SET OVERFLOW
E-6	NMI	NMI	NMI	NMI
E-7	RESET	RESET	RESET	RESET
E-8	DATA BUS 7	DATA BUS 7	DATA BUS 7	DATA BUS 7
E-9	DATA BUS 6	DATA BUS 6	DATA BUS 6	DATA BUS 6
E-10	DATA BUS 5	DATA BUS 5	DATA BUS 5	DATA BUS 5
E-11	DATA BUS 4	DATA BUS 4	DATA BUS 4	DATA BUS 4
E-12	DATA BUS 3	DATA BUS 3	DATA BUS 3	DATA BUS 3
E-13	DATA BUS 2	DATA BUS 2	DATA BUS 2	DATA BUS 2
E-14	DATA BUS 1	DATA BUS 1	DATA BUS 1	DATA BUS 1
E-15	DATA BUS 0	DATA BUS 0	DATA BUS 0	DATA BUS 0
E-16	K6	30	-12 VOLTS REG.	* (reserved)
E-17	SINGLE STEP OUT	DB OUT	+12 VOLTS REG.	* (reserved)
E-18	(N.C.)	POWER ON RESET	CS8	* +7.5 UNREG
E-19	(N.C.)	(N.C.)	CS9	* VECTOR FETCH
E-20	(N.C.)	(N.C.)	CSA	* DECODE ENABLE
E-21	+5 VOLT REG.	+5 VOLT REG.	+5 VOLT REG.	+5 VOLT REG.
E-22	GROUND	GROUND	GROUND	GROUND
E-A	ADDR BUS 0	ADDR BUS 0	ADDR BUS 0	ADDR BUS 0
E-B	ADDR BUS 1	ADDR BUS 1	ADDR BUS 1	ADDR BUS 1
E-C	ADDR BUS 2	ADDR BUS 2	ADDR BUS 2	ADDR BUS 2
E-D	ADDR BUS 3	ADDR BUS 3	ADDR BUS 3	ADDR BUS 3
E-E	ADDR BUS 4	ADDR BUS 4	ADDR BUS 4	ADDR BUS 4
E-F	ADDR BUS 5	ADDR BUS 5	ADDR BUS 5	ADDR BUS 5
E-H	ADDR BUS 6	ADDR BUS 6	ADDR BUS 6	ADDR BUS 6
E-J	ADDR BUS 7	ADDR BUS 7	ADDR BUS 7	ADDR BUS 7
E-K	ADDR BUS 8	ADDR BUS 8	ADDR BUS 8	ADDR BUS 8
E-L	ADDR BUS 9	ADDR BUS 9	ADDR BUS 9	ADDR BUS 9
E-M	ADDR BUS 10	ADDR BUS 10	ADDR BUS 10	ADDR BUS 10
E-N	ADDR BUS 11	ADDR BUS 11	ADDR BUS 11	ADDR BUS 11
E-P	ADDR BUS 12	ADDR BUS 12	ADDR BUS 12	ADDR BUS 12
E-R	ADDR BUS 13	ADDR BUS 13	ADDR BUS 13	ADDR BUS 13
E-S	ADDR BUS 14	ADDR BUS 14	ADDR BUS 14	ADDR BUS 14
E-T	ADDR BUS 15	ADDR BUS 15	ADDR BUS 15	ADDR BUS 15
E-U	PHASE 2	PHASE 2	PHASE 2	PHASE 2
E-V	READ/WRITE	READ/WRITE	READ/WRITE	READ/WRITE
E-W	READ/WRITE	READ/WRITE	READ/WRITE	READ/WRITE
E-X	PLL TEST	AUDIO TEST	AUDIO TEST	* +16 VOLT UNREG.
E-Y	PHASE 2	PHASE 2	PHASE 2	PHASE 2
E-Z	RAM R/W	RAM R/W	# RAM R/W	RAM R/W

* These signals are not bussed to the CPU slot.
\# Signal generated is different from KIM-1 and SYM-1.

Fig. 6 Processor and Modified Expansion Bus Signals ©

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Cassette I/O With AIM 65 BASIC

Michael Rathbun
Polar Solutions
Kodiak, Alaska

The AIM 65 is one of the few micro systems I have worked with which was packed with PLEASANT surprises. Its monitor, assembler, and BASIC do things I didn't expect from a piece of equipment in its price range. After a while, however, I found myself wishing that the excellent AIM cassette system could be used with the BASIC on the system for data input and output, instead of just for SAVE and LOAD. It turns out that, because BASIC uses certain monitor routines to interface the keyboard and display/printer, BASIC cassette file I/O is not all that difficult.

Monitor Routines

For those who haven't spent an exciting evening or two reading the assembly listing of the monitor which Rockwell provides, here is a brief summary of the I/O routines which BASIC uses.

Most of the AIM 65 functions which get data from the keyboard (i.e. Editor, BASIC, and even Assembler) do so by calling a monitor routine called INALL. INALL, however, is not just for accessing the keyboard. It will get a byte of data from ANY input device. Which device it goes to is determined by the contents of a memory location labelled INFLG, which is located at $A412. If this location contains a RETURN character ($OD) then the input will be from the keyboard. If INFLG contains an ASCII "T" (54), then INALL will look to the cassettes for data.

How does this location come to contain the proper value? The functions which allow a selection of input devices also make use of a subroutine from the monitor called WHEREI; it is this subroutine which displays the familiar "IN = " prompting message after the BASIC LOAD command is entered. If you respond to "IN = " with "T", the WHEREI routine then also asks for a file name ("F = ") and then finds out which cassette you will use ("T = "). From this time on, any time INALL is called, a byte of data from the specified tape file will be returned.

Output works in a similar fashion; there is a subroutine called OUTALL which will output a byte of data to any AIM 65 output device, depending on the contents of a location labelled OUTFLG, which is located at $A413. This location is set to the desired value by a subroutine called WHEREO, which is the one which generates the "OUT = " prompt.

Utilization

Making your BASIC programs read from cassettes is quite simple--most of the work has been done for you by the program logic used by the LOAD command. When you type LOAD and give the cassette file information, BASIC simply takes its input data from the tapes instead of from the keyboard, continuing to do this until a CONTROL Z character ($1A) is read from the tape. The CONTROL Z causes control to return to the keyboard. If your program contains a step with the LOAD command (for example, 100 LOAD) then when this step is executed, you will see the "IN = " message. If you specify input from a cassette file, then from that point on, until a CONTROL Z is read, or until INFLG is changed to a RETURN character, every INPUT statement in your program will take data from the tapes instead of from the keyboard.

When you reach a point in your program when you wish to switch input back to keyboard, simply POKE a RETURN into INFLG. If you want to intermix INPUTs from keyboard and tape, you can change the input device back and forth at any time by changing the contents of INFLG. Remember, though, that if your program bombs with an error while INFLG points to the tapes, the system will go on trying to get its data from the tape file; you will have to use the RESET button to regain control of the situation.

For writing data to cassettes, the procedure is a little more complex; there is no BASIC command which will change OUTFLG. The SAVE command will access the tapes, all right, but all it does is LIST the program and return to keyboard control. However, this sequence of steps will work:

1. POKE the address of the WHEREO routine into locations 4 and 5.
2. Execute a USR(X) statement. This will cause BASIC to call WHEREO.
3. Output data is required using regular PRINT statements.
4. When output is finished, you will need to close the file properly. Do this by PRINTING CHR$(13) and CHR$(26). This puts an AIM Editor end-of-file mark on the tape, followed by a CONTROL Z, just to be safe. Then POKE the address of the routine called DU11 (see table of locations) into locations 4 and 5, and execute a USR(X) statement. This will end the cassette file properly, and also will restore output to the display.

Notes and Cautions

If the OUTFLG is set to send output to tapes, and your program bombs with an error message for some reason, you will never see the error message — it will have been written to tape! For this reason, it is a good idea to debug programs using regular keyboard input and display output before using cassettes; also, it might be wise to "turn off" the cassettes when not actually reading or writing, by POKEing a RETURN into INFLG or OUTFLG after a state-

ment which accesses tape. This allows you to intermix keyboard-display and cassette operation.

You can use both input and output in the same program, but unfortunately, NOT AT THE SAME TIME. The reason for this restriction is as follows: the monitor cassette routines store data on tape in 80-byte blocks. The data going to or from a block on tape is stored temporarily in a buffer area in memory. If INFLG and OUTFLG are both "T", then the cassette write routine uses a different buffer from that used by the read routine. This buffer is located on page zero, right in the middle of the area BASIC uses for its math operations. Therefore, if the same program is going to do both reading and writing, it must finish completely with one operation before it initializes the other. A procedure which eliminates this restriction (but requires assembly-language routines and some memory overhead) was reported in the first issue of Rockwell's new publication INTERACTIVE. The method used here is considerably simpler, but limits you to read-only or write-only at any given instant.

Sample Programs

The two sample programs were developed to fill a need in a project I was working on. The first writes a table of about 600 prime numbers to tape; the second program reads this table from tape into an integer array, and uses this array to print the factors of a number entered from the keyboard. While not elegant examples of the programmer's art, they do show the implementation of the procedures detailed here.

Location Table

Label	Hex	Decimal	Function
INFLG	A412	42002	Defines input device
OUTFLG	A413	42003	Defines output device
WHEREI	E848	59464 Low byte = 72 High byte = 232	Initialize INFLG
WHEREO	E871	59505 Low byte = 113 High byte = 232	Initialize OUTFLG
DU11	E50A	58634 Low byte = 10 High byte = 229	Close active tape file

List

```
0 REM SET UP OUTPUT TAPE FILE.
1 POKE 4,113: POKE 5,232
2 N = USR(N)
5 UL = 600: REM DEFINE TABLE LIMIT HERE
10 DIM X%(UL)
20 X%(1) = 2: X%(2) = 3
30 L = 2
90 N = 3
100 I = 1
110 IF INT(N/X%(I)<>N/X%(I) THEN 200
120 N = N + 2 GOTO 100
200 IF X%(I) = >SQR(N) THEN 300
210 I = I + 1: GOTO 110
300 L = L + 1: X%(L) = N
309 REM OUTPUT TO TAPE.
310 PRINT N
314 REM ALSO SHOW NUMBER ON DISPLAY.
315 POKE 42003,13: PRINT N: POKE 42003,ASC("T)
320 IF L<>UL THEN N = N + 2: GOTO100
321 REM
329 REM WRITE END-OF-FILE MARK ON TAPE
330 PRINT CHR$(13); CHR$(26)
331 REM
339 REM CLOSE TAPE WITH DU11 ROUTINE.
340 POKE 4,10: POKE 5,229
350 N = USR(N)
360 PRINT" DONE."

10 DIM A%(600)
20 A%(1) = 2
90 REM SET UP TAPE INPUT.
100 LOAD
115 REM READ DATA FROM TAPE TO ARRAY.
120 FOR I = 2 TO 597: INPUT A%(I): NEXT
125 REM TURN OFF TAPE.
130 POKE 42002,13
200 INPUT X
205 PRINT! "**";X
210 Q = 1
220 IF INT(X/A%(Q) = X/A%(Q) THEN 230
225 Q = Q + 1: GOTO 240
230 PRINT! A%(Q): X = A/A%(Q)
240 IF SQR(X) = >A%(Q) THEN 220
250 PRINT! X: GOTO 200
```

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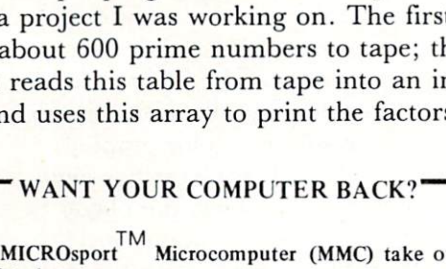

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New Products

Commodore Business Machines Announces Availability Of Emergency Relief Plan Application Program

Commodore Business Machines, a Division of Commodore International Limited has announced the availability of a disaster/emergency plan computer application program.

As a result of the Commodore experiences during the COMDEX 80 exposition and the tragic fire at the MGM Grand Hotel in Las Vegas, November 22, 1980, the strikir.g need for immediate information dissemination on the whereabouts and status of the hotel guests and employees was apparent. With the consent and encouragement of Commodore's Vice Chairman and Chief Executive Officer, Mr. Jack Tramiel, Commodore removed seven complete computer systems from the COMDEX booth and established a computer command center.

Marge Jillett, Director of Public Relations recruited volunteers to man the command center until three a.m., Sunday, November 24, 1980. Brian Padol, representing Micro Search, Inc. adapted a Commodore information list management system program to allow volunteers to type the name, address, MGM room number and the site of relocation of the thousands of guests. Lists were compiled, printed and distributed throughout the night.

Lieutenant Ross of the Las Vegas Metropolitan Police Department stated "We were not equipped to handle a disaster of this magnitude without the computers and personnel". The Commodore "command center" became a vital information source for the police, the fire department, Red Cross and other disaster relief organizations.

Commodore Business Machines Inc. will release to its over 500 dealers this disaster relief program and document its experiences so that should an emergency of this magnitude occur again, the Commodore dealer can assist all local disaster relief organizations within their area, in the continuing concern to assist the public.

New Product releases are selected from submissions for reasons of timeliness, available space, and general interest to our readers. We regret that we are unable to select all new product submissions for publication. Readers should be aware that we present here some edited version of material submitted by vendors and are unable to vouch for its accuracy at time of publication.

Chess And Checkers Programs For Atari Personal Computers

SUNNYVALE, CA — January 22, 1981 — Personal Software Inc. has introduced MicroChess™ and Checker King™ for the Atari ™ 400 and 800 personal computers.

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Checker King brings the popular game of checkers to Atari home computers. The program turns the computer display screen into a colorful checkerboard, where all pieces are — like MicroChess — illustrated using high-resolution graphics.

Checker King allows single, double and triple jumps, forces jumps and performs according to the tournament rules of checkers. And, again like MicroChess, Checker King allows no illegal moves at any of its eight levels of play.

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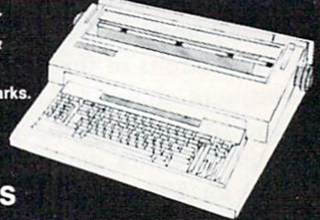

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Option available to allow your 221 to access the Teletype & Telenex networks.

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Both MicroChess and Checker King for the Atari are available on cassette for Atari 400 and 800 personal computers and both require 8K bytes of memory. MicroChess was written by Peter Jennings; Checker king is by Michael Marks.

For more information, please contact Jeff Walden, Personal Software, Inc., 1330 Bordeaux Drive, Sunnyvale, CA 94086.

Atari, Atari 400 and Atari 800 are registered trademarks of Atari, Inc. MicroChess and Checker King are trademarks of Personal Software Inc.

Real Estate Analyzer

A new edition of the "REAL ESTATE ANALYZER by HowardSoft" is now available for Apple Computers. This software package is unique in its realistic handling of TODAY'S market conditions for real estate investments: creative financing, negative cash flows, component depreciation, high property inflation, rent control, property tax limitations, high returns on near-term income, and inflationary increases in operating expenses.

The software provides projections of annual cash flows and on-sale return-on-investment, as well as several other measures of profitability, including all the consequences of ordinary and capital gains taxes as well as inflation. Data for your properties are easily filed on disk for later retrieval and alteration. Results are displayed on the video screen or printed with a line printer in a flexible report format with complete itemized tables. The package comes with two disks and a detailed instruction manual in a quality notebook, complete with explanations of the principles of investment analysis. More complete and realistic than packages costing many times more, this product sells for $99 at dealers everywhere. (Requires Apple Computer with 48K, Applesoft ROM, and disk drive.) HOWARD SOFTWARE SERVICES, 7722 Hosford Avenue, Los Angeles, CA 90045, (213) 645-4069.

Cimarron Announces An Attorney Package For Commodore's 8032 Business Computer

Costa Mesa, CA./ Cimarron Corporation has announced a major applications package programmed exclusively for the legal profession. Incorporating both accounts receivable and matter tracking, Legal Time Accounting (LTA) offers law firms with an inexpensive solution to the problems of managing the daily flow of words and information.

LTA proceduralizes daily operations by logging each activity e.g., conference, telephone time, etc., then stores this data by matter and lawyer. The resultant data provides for control of receivables, tracking of attorney activity and revenue and tracking of client and matter activities — all with daily and monthly totals. Reports include aging analysis, attorney billings with ratios, client billings with ratios, activity code analysis and a daily charges and payments journal. Statements can be generated twice monthly allowing for more predictable cash flow. General ledger and accounts payable are also available.

LTA is programmed specifically for the Commodore 8032 computer system utilizing either the 4040 or 8050 twin diskette drives. Compatible printers are the NEC Spinwiter or C. Itoh's Starwriter. Both printers allow for printing of fully formed characters so that the popular WordPro word processing program can be used in conjunction with LTA. In its full hardware configuration, an automatic sheet feeder is added providing for continuous, hands-off operation.

According to Michael C. Miller, developer of LTA and co-founder of Cimarron, the advanced design of the program represents the first time high quality applications software created for minicomputers has been made available on the now more powerful Commodore business computer.

LTA is priced at $900.00 per copy and includes documentation and support materials. For high volume dealers, Cimarron will offer a one time charge. Additionally, Cimarron will pre-package and fully test the entire system for those dealers wishing turnkey installation. Sales and program training are also available.

For more information, please contact Daniel M. Gomez, Cimarron Corporation, 600 Baker Street, Suite 319, Costa Mesa, CA 92626. (714)641-1156

Apartment Management Software Package

Norcross, Georgia — MIN Microcomputer Software, Inc., has announced The Landlord™, an apartment management software package for Apple II® computers. The system can be used by apartment properties of up to 400 units.

The Landlord™ provides property owners and managers with listings of apartments, residents, and past residents, as well as reports on vacancies, lease expirations, intents to vacate, and resident payments. Records of disbursements and other financial transactions are maintained by the system and a monthly property analysis statement is produced.

The Landlord™ allows entry of resident charges and payments using up to 26 different account codes. Security and pet deposits, returned checks, and overpayments are also handled by the system. An outstanding balance report allows expedient follow-up of delinquent residents.

The package is designed to be used by managers who have no prior computer or data processing experience. The manual included with The Landlord™ as well as the

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instructions that appear on the Apple's® screen are completely non-technical in nature.

Suggested retail price for The Landlord™ is $795.00. The software requires an Apple II® computer w/48K RAM, 2 disk drives, and either a Silentype® or Centronics 779 printer. The Landlord™ will be sold exclusively through retail computer outlets.

MIN Microcomputer Software, Inc. specializes in the development of software packages for specific small business applications.

For more information, please contact Art Nacht, MIN Microcomputer Software, Inc., 5835-A Peachtree Corners East, Norcross, GA 30092. (404) 447-4322.

The Landlord is a trademark of MIN Microcomputer Software, Inc. Apple, Apple II, and Silentype are registered trademarks of Apple Computer, Inc.

1981 Tax Preparer

The 1981 Edition of the "TAX PREPARER by HowardSoft" is now available for Apple Computers. The new edition has several improvements over the acclaimed 1980 version, including continuous-stream printing for professional tax preparers, printouts that can be filed directly with the IRS, expanded documentation in a quality notebook, and the addition of Form 2210 to the long list of built-in forms (Schedules A, B, C, D, E, F, G, R&RP, SE, TC, and Forms 1040, 2106, 3468, 4562, 472, 4797, 5695).

Unique features include on-screen facsimiles of IRS forms during preparation, easy creation, filing, and editing of itemized lists to support any entry, automatic computing of all arithmetic, automatic linking of results of various forms, and easy comparison of alternative tax strategies. More complete and easy-to-use than packages costing many times more, this package comes with two disks and professional documentation, and sells for $99 at dealers everywhere. (Requires Apple Computers with 48K, Applesoft ROM, and at least one disk drive.) HOWARD SOFTWARE SERVICES, 7722 Hosford Avenue, Los Angeles, CA 90045, (213) 645-4069.

Super X-10 Mod From CMC For Home/Office Security Systems

The SUPER X-10 MOD, recently introduced by Connecticut microComputer, Inc. allows direct computer control over the basic components in a home/office security system.

Developed for use with most popular microcomputers, including PET, APPLE, TRS-80, and KIM, the MOD controls up to 256 different remote devices by sending signals over house wiring to readily available BSR remote modules. These low cost modules, in conjunction with the SUPER X-10 MOD, allow microcomputer control over lamps, motors, and appliances. With eight digital inputs and eight digital outputs included, the SUPER X-10 module can easily be connected to switches at windows and doors for sensing by the microcomputer. The module can be programmed so that the opening or closing of a window or door initiates a sequence of operations such as turning on lights, radio, and alarm, even if the computer is turned off. Direct, plug-in compatibility and software are available for most microcomputers.

In addition, the SUPER X-10 MOD can put kitchen appliances, stereo systems, television, motors, fans, pumps, and laboratory equipment under computer control. With the module, additional service from microcomputers in business and small industrial applications is now possible. A clock and calendar which can be read by microcomputers are also incorporated into the module. Suggested single unit pricing for the SUPER X-10 is $249, and the module is available from CMC factory stock or from one of a select group of personal computer dealers.

For further information, write: SUPER X-10 MOD, Connecticut microComputer, Inc., 150 Pocono Road, Brookfield, CT 06804

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MANUAL INCLUDED - Comprehensive instruction manual included.

INDEPENDENT - XDOS uses no RAM, and BASIC is unaffected by its use.

COMPATIBILITY - XDOS is compatible with most other ROM products and can be ordered to fit any of the three available ROM sockets.

SORT ROM™ – $97.50 Every serious program can benefit from the five utilities included:

SORT - This command takes a list of array names (string, real and integer in any order or mix) and sorts them based on the alphabetic or numeric order of the first array in the list. An example best illustrates the flexibility of this command: Suppose you wish to maintain an invoice list with the data held in the following arrays:

C%(N) = Customer Number, **I%(N)** = Invoice Number, **A(N)** = $ Amount, **D$(N)** = Date. It is now a simple matter to put this list into order of invoice date, customer number or amount owing. An Accelerated Headsort algorithm with K · N · Log(N) characteristics is used for extremely fast speed even on worst case data.

SORT TIME IN SECONDS				
NO. OF RECORDS	1,000	3,000	5,000	10,000
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REAL	4.9	16.7	29.3	-
STRING	3.8	13.3	-	-

READ STRING - This command is a much needed replacement for INPUT# with the following improvements. Maximum input string length increased from 80 to 254 characters. Embedded COMMAS, COLONS and QUOTES are now acceptable data. Null string is returned for empty records.

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FIND SUBSTRING POSITION - POS is a very fast string search function which locates the position of one string within another.

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Scientific Plotter for APPLE II

STATE COLLEGE, PA...Interactive Microware, Inc. has announced a program called Scientific Plotter which produces professional-looking graphs. Plotting your results with Scientific Plotter is much easier, faster, neater and more accurate than plotting your data by hand. Data may be input from the keyboard, from the disk or it may be calculated by your own subroutine. In each case, the data may be supplied either as X,Y pairs or as Y values at a constant X interval. Since 20 different plotting symbols are provided, you may plot more than one set of data on the same graph. Also, error bars of variable length may be used to indicate the range of error for each point.

Scientific Plotter gives you complete control of the length and position of each axis, the grid size and the interval between numbers that are printed along the axes. Thus, it is possible to plot data in one, two or four quadrants and different scales may be specified for up to four axes. Any number of labels may be superimposed on the graph, using an alphabet of 76 letters and scientific symbols which can be printed in four different orientations at 90 degree angles. The finished graph may be saved on disk for later review or it may be printed on a graphics printer.

Many features of Scientific Plotter make it easy to use. The program displays the allowable range for input values, based on previous answers, and warns of any errors. At any time, you may erase the graph and replot it with any desired changes. All previous answers become the defaults, so that you can make changes quickly. After the best format for your graph has been selected, that format may be saved on disk for subsequent use with similar data. Five demonstrations are included on the disk so that you will learn quickly how to construct various types of graphs.

Scientific Plotter requires a 48K APPLE II computer with Applesoft ROM. It is supplied on a disk with a 25 page manual for $25. The manual may be purchased separately for $5, refundable with purchase. For further information, contact Paul K. Warme, Interactive Microwave, Inc.; P.O. Box 771; State College, PA 16801 or call (814) 238-8294.

PET Software Vendor Expands

Microphys has announced the conversion of its entire educational software line for use on the Apple II/Bell & Howell microcomputers. Over 160 programs are described in our new Winter catalog. These computer-assisted instruction and individualized-instruction programs have been successfully employed in

Chemistry, Physics, and Calculus classes (on both the high school and college levels) and in junior and senior high school Mathematics and English classes. These programs continue to be available for use with the Commodore PET/CBM systems.

For more information, please contact Microphys Programs, 2048 Ford Street, Brooklyn, NY 11229. (212)646-0140.

Hayden Unveils Gameware™ Series

ROCHELLE PARK, NJ—Hayden Book Company, Inc. has announced a new computer game series, called GAMEWARE™. The GAMEWARE series features high-quality, attractively-packaged computer games.

The first three games in the series are: Hayden's REVERSAL™, winner in the software division of the First International Man-Machine Othello Tournament; BLACKJACK MASTER™, a game that allows players to test their betting and playing strategies over thousands of games in minutes; and the famous SARGON II™ chess game.

According to Steven Radosh, Hayden's Software Games and Entertainment Editor, "Hayden's GAMEWARE features the finest microcomputer games on the market, attractively packaged with four-color art, shrink-wrapped, and suitable for rack or shelf display."

Radosh said Hayden plans an extensive promotion program for the GAMEWARE series.

All three initial games in the GAMEWARE series will be available from Hayden in December 1980. For more information, contact: Steven Radosh, Hayden Book Company, Inc., 50 Essex Street, Rochelle Park, NJ 07662, (201) 843-0550.

*Gameware, Reversal, Blackjack Master and Sargon II are trademarks of Hayden Book Company, Inc.

32K Ram Expansion For Atari 400, 800 Announced

Sunnyvale, Calif.—AXLON, Inc. of Sunnyvale has announced its new memory expansion system for the Atari 400 and 800 personal computers.

According to John Vurich, AXLON's President, the memory modules, called RAMCRAM™, can expand the Atari 400 system to 32K, and the Atari 800 to up to 48K-bytes of random access user memory. RAMCRAM contains 16 memory chips, yielding a total of 32K-bytes of additional user program memory.

In the case of the 400, RAMCRAM is installed by removing the top enclosure of the computer console and unplugging the 8K RAM module supplied by Atari. The RAMCRAM module is then plugged into the same slot.

According to Vurich, this modification allows the user of the 400 system to plug in disk drives, printers, and any other peripheral devices formerly compatible only with the much more expensive Atari 800 product. "It really lets one upgrade a 400 to provide all of the capabilities of the 800 with 32K of RAM," he commented. "Any 32K Atari 800 software on the market will run on a 400 with RAMCRAM."

The advantages of RAMCRAM over the Atari plug in memory modules are a little less obvious when it is used with the 800 system. But users with future expansion in mind will immediately see that putting a full 32K-bytes into one memory slot allows upgrading of the system to 48K with one entire slot left over for future expansion.

Are there any devices that can use the extra slot? According to Vurich, "There are many things in the near future." While somewhat reluctant to discuss future products, he did mention that a bus extender could be plugged into the third slot. Such an extender might terminate on the other end with a series of "slots" for use in plugging in "all sorts of interesting things."

This is reminiscent of Atari's competitors who use built-in slot connectors for connection of printers, modems, terminals, and other devices intended to establish contact between the computer and the outside world.

Developing the logic necessary to make the system "think" that two slots are being used instead of one was a relatively small problem for Vurich and his fellow designers of the RAMCRAM modules. The Atari operating system actually does some bank selecting anyway, and they were able to take advantage of this for their own purposes.

"The whole idea", says Vurich, "is to take the Atari 400 system out of the sophisticated toy category and turn it into a useful computer tool." With the ability to plug in printers, disk drives, and other previously incompatible Atari 800 peripherals, Axlon has certainly accomplished that goal!

For more information, please contact John Vurich, AXLON, Inc., 170 N. Wolf Rd., Sunnyvale, CA 94086

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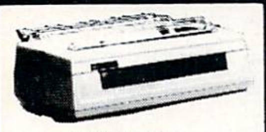

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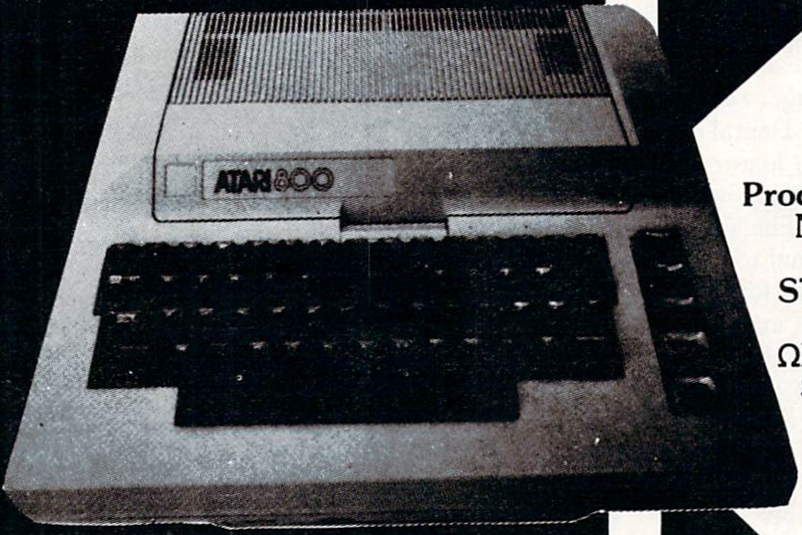

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The first new package, called Professional I, is for the Dental Professional. The system features preparation of A.D.A. claims forms for third party patients. The system also allows the professional to locate and prepare notices for professional dental checkups automatically on the schedule the dentist feels advisable for his patients.

The second package, called Professional II, is geared to the needs of the legal profession. The system features preparation of special reports for third party legal plans and special accounting plans to analyze court time usage, and work on retainer or contingency engagements.

The third package variation, called Professional III, is a general purpose package for consultants, accountants and contract administrators. This system allows the creation of sub-jobs, special cost centers, overhead accounts, billing under time and materials contracts, fixed priced job cost accounting and many other job set up systems.

All systems include daily cash reports, time utilization, and professional service reporting. Monthly reports include full aged accounts receivables by client and class of client as well as third party payors. Management and analysis package which is so flexible it can be used to manage personal finances or client trust account funds.

All systems require an Apple II or Apple II Plus computer with Applesoft, a 130 column printer, and at least two mini practitioners with client bases of up to 10,000 clients each.

The systems are available from CompuSoCo at a single site license cost of $750.00 for the selected package. Additional information is available from CompuSoCo, 26251 Via Roble, P.O. Box 2325, Mission Viejo, California 92690.

Hellfire Warrior, Sequel To Temple Of Apshai, Now Available

Automated Simulations, is now offering the sequel to the best-selling Temple of Apshai, Hellfire Warrior.

Like the Temple of Apshai, Hellfire Warrior is a fantasy role-playing adventure, but with more magic, more detail and more command options. Hellfire Warrior lets the player take on the role of his favorite hero.

The player must rescue the beautiful warrior maid Brynhild from the depths of a four-level dungeon and bring her back to sun and air.

Hellfire warrior has more than 200 rooms—riddled with trap doors, bottomless pits, and filled with monsters and treasures, and the player must kill the great bat-winged demon, cross bridges of flame, face death itself and live before the adventure is complete.

Hellfire Warrior is a game for experienced fantasy role-playing gamers. Even more challenging than The Temple of Apshai, Hellfire Warrior allows the player to explore four levels of 60 rooms each.

The magical rooms of level five are inhabited by giant insects. On level six, the player must search for the only exit, hidden within the labyrinth. And on level seven, the player must do battle with skeletons, ghouls, mummies and even invisible ghosts.

The culmination of the adventure lies on level eight. But first the player must overcome the legions of the lost souls in an underworld guarded by dragons and riddled with bottomless pits and blasts of hellfire.

Hellfire Warrior includes an armory where the player must bargain with a tight-fisted innkeeper for five types of armor, five kinds of swords and shields in two sizes. He will also find 13 kinds of potions and healing ointments to choose from. At the Magic Shoppe—if the player has enough money, he can have ordinary weapons transformed into Magical ones.

Hellfire Warrior is available on cassette for the PET (32K) and TRS-80 (Level II, 16K), and on disk for the TRS-80 (32K) and the APPLE (48K with ROM Applesoft) for $39.95 from Automated Simulations, P.O. Box 4247, Mountain View, CA. 94040.

Space Wargame

Strategic Simulations has just released its first space wargame, The Warp Factor. The game allows one or two players to choose from among 12 starship designs representing 5 Galactic Empires. The player(s) are placed squarely in the Captain's role, dealing with the critical parameters of interstellar battle such as energy allocation for phasers, shields, disruptor bolts, screens, and warp engines. With an average game lasting between thirty minutes and four hours, the player(s) can create scenarios ranging from space skirmishes to a full-scale, all-out star war. For $39.95 the game comes complete with a Starship Operating Manual, 3 Starship Data Cards, and a Game Selection Card. The Warp Factor is available on disc for a 48k Apple II (Applesoft ROM).

For more information, please contact Stratetic Simulations Inc., 465 Fairchild Drive, Suite 108, Mountain View, CA 94043. (415)964-1353.

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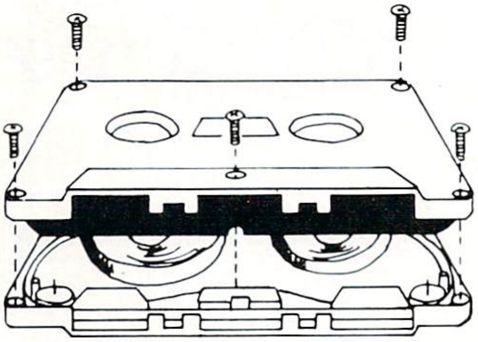

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The tape used in our cassettes is of studio quality, The same type of tape is used by some studios for making master recordings. The magnetic tape used in the cassette is the true heart of the cassette. You can have the best shell made, but with low quality tape it is still junk.

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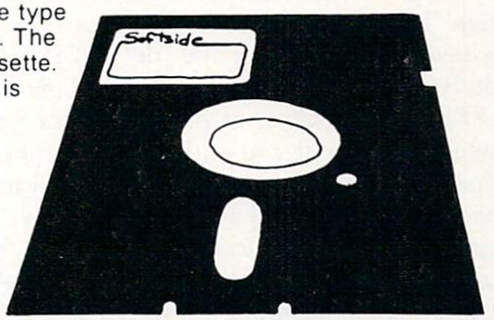

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Hooray for SYS (Correction)

Harvey B. Herman
Greensboro, NC 27412

There is a problem with the APPEND programs (Jan. 1981 COMPUTE!) for "old" and "new" PETs. I recently learned that there are four kinds of PET cassette tapes. Unfortunately, in my ignorance, I only tested two types, both of which worked. The third very common PET tape, made with "new" ROMs, was ignored and, in fact, does not work. An easy fix which will cover most, but not all, cases is to change line 230, in both APPEND programs to:

```
230 C = C - 3:T = C + 1 : IFPEEK(635) = 0 THEN
C = C - 1:T = T - 2
```

The programs will now work with the PET tapes which users are most likely to encounter. It may be instructive to discuss the remaining problems in more detail as readers may not be aware of it and could come to grief, as I did.

Both versions of APPEND were designed to work with tapes made on "old" and "new" machines. There is a difference in tapes — original ROMs save starting at hex 400 (dec 1024) and upgrade ROMs save starting at hex 401 (dec 1025). The APPEND programs, as published, checked for start save at statement 230 and made a minor correction depending on which machine was used to make the tape. What I did not know was that new machines saved one byte less on either end. A short program which is written and saved on an "old" machine saves, for example, from hex 400 to hex 424 (call this case 1). The same program, if written and saved on a new machine (call this case 2) would be saved from hex 401 to hex 423 (one less on both ends). If the case 1 tape for the example program, is loaded into a "new" machine and saved, we get a tape which I will call case 3. This tape is a hybrid of cases 1 and 2. Locations saved are from hex 401 to hex 424. My tests for APPEND were done unwittingly with case 1 and case 3 tapes. The line 230 correction discussed above, will allow the program to work with case 2 tapes. Hybrid case 3 tapes will not work but can easily be converted to case 2 after loading by decrementing the location pointer at hex 28 and 29 (dec 42 and 43) and resaving the program. Thus, after loading our short example (case 3 or case 1 tape) change location hex 28 (dec 42) from hex 24 (dec 36) to hex 23 (dec 35) and save again. This new tape (now case 2) and the old one (if case 1) will both append properly. There is also a hybrid case 4 which requires the location pointer on old PETs to be incremented but I think you get the idea.

I want to thank Brien L. Wheeler for calling my attention to a possible error in APPEND and apologize to all readers for this inconvenience.

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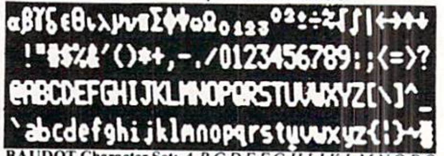

BAUDOT Character Set: *A B C D E F G H I J K L M N O P Q R S T U V W X Y Z - ? : • 3 $ # ( ) . , 9 0 1 4 ! 5 7 ; 2 / 6 8* • **Cursor Modes:** *Home, Backspace, Horizontal Tab, Line Feed, Vertical Tab, Carriage Return. Two special cursor sequences are provided for absolute and relative X-Y cursor addressing* • **Cursor Control:** *Erase, End of Line, Erase of Screen, Form Feed, Delete* • **Monitor Operation:** *50 or 60Hz (jumper selectable.*

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David Ahl, Founder and Publisher of Creative Computing

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Robert Lock, Editor/Publisher

We are always seeking good material for publication in **COMPUTE!**. I cannot overstress our interest in material for the beginner; in short (e.g. 1 page or so) programming hints; in material that crosses "machine boundaries". We present a mix of long articles and short ones. Length is not a criteria of success. Frequently our most favored articles have been simple, provocative programs.

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